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A COMPARISON OF NATIONAL LUMINOUS SOURCES.

As a secondary standard of luminous intensity, the incandescent lamp is unrivalled. When properly aged and prepared, it only needs to have its specified volts maintained at terminals in order to deliver a steady and definite candle-power in a definite direction or directions. If such lamps could be manufactured in such a manner that their candle-power could be precisely determinable beforehand, no better primary standard could be desired. Unfortunately, we all know that it is impossible to predetermine the luminous intensity of incandescent lamps, except in a very rough way. Every standard incandescent lamp has first to be standardized by reference to a primary standard. Attempts at securing a universal or international primary concrete standard of light have failed. At the present time England, France and Germany has each its own standard fuel-flame. They all burn air, but otherwise the fuels differ. England burns pentane gas, France liquid colza-oil, and Germany liquid amyl-acetate. England used to burn solid spermaceti in the form of a standard candle, but since the departure of the whale to that bourne from which no mammal returns, the English parliamentary candle has ceased to be the concrete standard of English light.

The *Journal für Gasbeleuchtung und Wasserversorgung* has recently published the results of a research conducted at the Reichsanstalt of Berlin upon the comparison of the above three luminous sources, namely, the English 10-candle pentane standard, the French carcel and the German hefner lamp. In the precise use of flame standards various precautions have to be taken, in regard to the air consumed. It must be fairly quiescent, of nearly standard pressure, of roughly normal temperature, of nearly standard dryness and nearly standard carbonic-acid content. Just as the vital processes of human beings are depressed when excessive carbonic acid is contained in the air inhaled, so lamps dim appreciably, under like conditions. The final results make the pentane standard equal to 11.0 hefners, and the carcel standard 10.8 hefners; so that the English pentane and the French carcel are nearly on a par, the English being a shade the stronger in its light. The English pentane is nominally of ten candles, and was organized so as to permit retaining of the old nomenclature and classification in regard to standard candles and candle-power. Incidentally, it is pointed out that the nominal English candle of one-tenth a pentane is weaker than the original spermaceti candle by about 4 per cent., so that in giving up its ghost to pentane, the British candle appears to have depreciated to that extent.

This fact is of appreciable industrial importance in the United States, because electrical engineers in this country commonly use the hefner lamp as primary standard. The original British candle of spermaceti used to be rated as 1.14 hefners. Now the Reichsanstalt makes the new nominal British candle 1.1 hefner, or, putting the matter in another way, we used to take the hefner as 0.877 British parliamentary candles, burning 120 grains per hour. Now, according to the new pronunciamento of the Reichsanstalt, we shall have to take the hefner as 0.909 British nominal candle, as defined through the pentane. All our incandescent lamps receive a free gift of 4 per cent in candle-power by reason

of the new edict. Of course gas lamps receive a similar bonus. The conclusions point to the importance of an international standard of light. All nations ought to have the same standard, even though that standard is not the best. It would not, then, be possible to have lamps jump 4 per cent in candle-power, on paper, because of official comparisons. It is the old story of bimetallism, come to light.

The Fixation of Atmospheric Nitrogen.

The description of the Norwegian nitrates plant which we publish this week is of far more than theoretical interest. If one stops to contemplate the result of a famine in natural nitrates the outlook is something astonishing. Bereft of nitric acid chemical manufacture would be in an exceedingly bad way all along the line. It is the universal cheap oxidizing agent in addition to all its more direct uses, and beyond this is the basis of practically all explosives. The Peace Society should view with alarm the new process as tending to the perpetuation of "villainous saltpetre" and all its militant train. From all reports the Birkeland and Eyde process seems to possess what previous processes have lacked, a rather high thermo-dynamic efficiency owing to the avoidance of wasteful reversed action, and the more effective application of the electrical energy; 70 per cent, which is the figure claimed, is certainly not at all a bad showing and the raw material is to be had for nothing.

As to the economic side of the process, the case is not yet clear. The reported consumption of electrical energy is about 4.1 kw-hour per lb. avoirdupois of nitric acid. If this figure can actually be maintained, the process looks feasible commercially when very cheap power can be obtained, especially as the product should be of rather a high grade. The strongest commercial acid costs in this country between 5 and 6 cents per pound by the carboy, and with proper allowance for dealers' profits it looks very much as if, using cheap water power as a source of energy, the synthetic acid might be able to compete, if not immediately, then at some not distant date when natural nitrates must inevitably be higher than at present. Then, too, the process may be subject to material improvement, as is usual in any new thing. It has often been the history of new chemical products that they have at first been hardly able to compete with the natural products, but later have pushed them hard. Such was the course of events in the manufacture of alizarine and of artificial indigo. The Notodden plant as now installed is on a commercial scale and its product of nitric acid and calcium nitrate should be large enough to give sound data for judging the commercial value of the process. If it succeeds, as we trust it may, it will open up a new use for electricity on a very large scale. The amount of nitric acid and nitrates used is tremendous, so that there need be little fear of over-production.

Especially is there use in a new industry like this as auxiliary to the complete development of water powers. The standing problem of hydro-electric engineering is the utilization of the entire available flow. Nature is unkind in furnishing so uneven a water supply as generally exists. There is a real need for industries that can take power at times when it is not otherwise usable and employ it in amounts sufficient to prevent waste. Pulp mills have sometimes proved very useful auxiliaries by doing this very thing, and electrochemical works may be made even more useful, especially in cases such as this where the raw material can be taken in without cost or at least very cheaply, and whereof the product can be conveniently stored. There are many hydraulic powers of which the flow available for power transmission purposes is moderate and impossible to be delivered at very low cost. Yet the same privilege may for four or five months have thousands of horse-power running over the dam. The market for such extra power is difficult to find, since it cannot fairly be described even as secondary power. It is, however, temporary power which for part of the year could be put to good use in electrochemical industries if these were of such a character as could be carried on discontinuously. Processes like the one here considered seem better able to meet these conditions than almost any others, and could be conducted very economically. Electric power from the surplus of the high-water months could be profitably furnished at below half a cent per kw-hour in many localities —far enough below in fact to give electrochemical processes now unremunerative a fair chance for profitable existence.

Polyphase Alternating-Current Magnets.

The ordinary properties of lifting electromagnets, excited by direct currents, are familiar through numerous practical applications. The properties of such magnets when excited by alternating currents are less familiar, and we have fewer of them. Polyphase alternating-current lifting electromagnets are so very select that we know very little about them from a practical or observational standpoint. An article by Mr. D. L. Lindquist, appearing in this issue on polyphase electromagnets, forms a sequel to an article on alternating-current magnets by the same author published in our issue of the 23d June. The alternating-current magnet has certain advantages and certain disadvantages, by comparison with the direct-current magnet. Among advantages are its greater impedance, whereby comparatively coarse windings may be utilized for ordinary voltages, and absence of tendency to stick, if the current is removed gradually. As disadvantages may be reckoned the loss of energy due to hysteresis and eddies, the consequent necessity of laminating the magnetic circuit, the cyclic variation in attractive force, and the tendency to hum, or even to chatter. The direct-current magnet keeps steadily to business, and makes no noise about it. The alternating-current magnet seeks to advertise its activity to the world at large in a very audible manner. The polyphase magnet possesses the interesting property, which has indeed been observed in past cases, of substantially constant pull, or lifting power, in this respect approaching the behavior of the direct-current magnet. On this account a part of the tendency to chatter is withdrawn. Nevertheless, as shown in the article, it is very necessary to employ a rigid construction, if the polyphase magnet is to be kept reasonably quiet when at work.

The alternating-current magnet bears a distinct resemblance to the alternating-current transformer. In fact, with such a magnet experimental observations may readily be made upon points which the ordinary construction of transformers does not permit of being investigated. One might at first sight suppose that these alternating-current electromagnets would not stick by residual magnetism when the current was cut off by the ordinary switch. But their behavior in this respect is very variable. Sometimes they do not stick at all. At other times they stick powerfully, unless an air-gap is introduced into the magnetic circuit. It all depends upon the particular phase of magnetic flux density at which the switch happens to break the circuit. If the circuit be broken on the top of a magnetic flux wave, there will be powerful residual magnetism in a closed magnetic circuit; but if broken at the zero of flux, there will be little or no residual pull. In the case of polyphase magnets it is to be supposed that there is never a moment of zero magnetic flux in the entire structure, and

with no air-gap the residual magnetic pull should be considerable, unless the exciting currents are removed gradually by the insertion of resistances. Researches in the practical behavior of alternating magnets are of importance, since we may expect to see such magnets develop greatly in application.

SERIES-PARALLEL ARMATURE WINDINGS.

To beguile the tedium of superincumbent hours, the heathen Mongol devised concrete structures of fiendish ingenuity as puzzles, which have become famous among Occidental nations under the name of Chinese puzzles. In recent years, however, the Occidents have outwitted the Chinese by the invention of armature-windings. As concrete structure puzzles, these are unrivaled for baffling curiosity and for amazing the uninitiated. Armature designers and armature winders are all but superhuman in the estimation of armature repairers. How many permanent inmates have been secured for our lunatic asylums by the inordinate study of armature-winding diagrams, statistics can never reveal. The main difference between armature windings and Chinese puzzles is that the former are a necessity of existence, and must be dealt with by the electrical engineering community, in order to carry on business; whereas the latter are like golf, only an amenity and are resorted to in order to justify neglect of business. To assist in unraveling and apprehending armature winding we fortunately have text-books, winding-tables, models, drawings and diagrams. Armature windings may be classified in various ways. One division is into symmetrical and dissymmetrical windings. Dissymmetrical windings may be defined as those in which the space relations of conductors, slots, poles and commutator-segments vary cyclically as the segments come successively beneath a brush; while in symmetrical windings, these relations remain the same as each segment comes beneath a brush. Dissymmetrical windings were not known until multipolar machines made their appearance. They came prominently into existence when multipolar armatures became series-wound, or presented only one pair of internal conducting paths between commutator brushes. The dissymmetry may differ both in kind, as well as in degree. There may be a dissymmetry, for example, in the number of conductors between brushes in different internal paths, or there may be a structural dissymmetry of such a nature as to call for dead or blank conductors in a certain slot or slots. In recent years a class of winding has been devised intermediate to parallel windings and series windings. In a multipolar parallel-winding, there are as many pairs of paths through the armature as there are pairs of poles. In a multipolar series-winding, there is only one pair of paths through the armature, despite the number of pairs of field-poles. Between these lies the class of series-parallel winding, in which the number of pairs of armature paths is greater than unity, but less than the number of pairs of poles.

In an important article by Prof. E. Arnold, on series-parallel armature windings, concluded in this number on page 130, careful consideration is devoted to the conditions of symmetry or dissymmetry. It will be readily seen that the field for possible dissymmetry in such windings is most fertile. We have to deal with a certain number of pairs of poles and of brushes. The number of commutator bars may be prime to that number. The number of slots may be prime to the number of commutator bars. The number of armature bars may be prime to the number of slots. Prof. Arnold shows that it is very desirable to employ cross-connections, or equipotential connections, between commutator segments of like polarity in this class of windings. They greatly improve the commutation, for reasons given in the article, even when the magnetic circuits through the armature are fairly well balanced. It is common practice to employ a suitable number of cross-connections in multipolar direct-current armature windings of the ordinary multiple and symmetrical type. In such cases, the advantage thereby secured is a security from magnetic-circuit dissymmetry. The cross-currents which tend to flow through these equipotential connections have such directions as tend to develop m.m.f's acting upon the field-poles in such a manner as to strengthen the weak poles and to weaken the strong, or to assist in restoring magnetic equilibrium. Cases have been known in which a large multipolar generator has been run in the factory for some little time with one of its field coils accidentally reversed—i. e., with three adjacent poles of the same sign; and although the armature heated unduly, the brushes did not give signs of bad behavior while running on light loads, so powerful was the influence of the corrective cross-currents around the reversed pole. Prof. Arnold gives a tabular statement near the end of his article concerning the behavior of sixteen multipolar series-parallel generators of different dimensions. It seems that above five electrical degrees of dissymmetry, the commutation becomes difficult, even with the aid of equipotential connections. The machine which had seven degrees of maximum dissymmetry had to be rebuilt, because it became too hot from internal currents.

The principal deduction from the paper is that series-parallel windings may be safely employed when the design does not reveal more than five electrical degrees of maximum dissymmetry, provided that a suitable number of equipotential connections is used. The question may arise in the minds of some designers as to why it should be necessary to resort to series-parallel multipolar windings when these give rise to such troublesome dissymmetry. The answer is that bars are much neater and stronger mechanically, are more economical of space, and are more readily adjusted. Bars should carry currents of not less than 60 amperes, nor more than 200. If the design be attempted for a multipolar generator on strictly parallel lines, the current in each bar may be much less than 60 amperes. On the other hand, if the design be attempted on series lines, the current per bar may be much greater than 200 amperes. Some series-parallel arrangement of bars is indicated in such cases. Special advantages in favor of series-parallel windings over parallel windings are claimed by Prof. Arnold, even when both are possible and open to selection. The considerations called up by the article illustrate the degree of mechanical precision which modern dynamo-machine construction demands. In a bipolar machine, an electrical degree is a mechanical degree; but in a 20-pole machine, an electrical degree is one-tenth of a mechanical degree; or is represented by six minutes of arc. Consequently, in such a machine, a tolerance of five electrical degrees of displacement means a limit of half a degree of mechanical displacement. Similar conditions are now known to affect synchronous motor-generator sets running in parallel. A phase displacement corresponding to five electrical degrees may be the limit of tolerance in some cases when two machines run in parallel sharing a load. With, say, 20 pairs of poles on the motor, this represents a tolerance limit of half a degree of mechanical displacement on the shaft, and the difference in subsequent machine behavior between setting its key in the shaft keyway with a snug fit, or with a driving fit, may be rendered apparent.

Hearing on Niagara Power Development.

All of the Niagara power development and transmission interests were represented at a hearing held by Secretary of War W. H. Taft in Niagara Falls on Thursday, July 12. The hearing was under the provisions of the Burton bill and took place in the International Hotel. Of the developing companies on the New York side there were represented the Niagara Falls Power Company, the Niagara Falls Hydraulic Power & Manufacturing Company, the Albion Power Company and the Lockport Hydraulic Company; also six other small interests in Lockport. The transmission companies represented were the Niagara, Lockport & Ontario Power Company, the Canadian Niagara Power Company and the Niagara Falls Transmission Company, as well as the International Railway Company.

Under the Burton bill the Secretary of War is authorized to grant permits for the diversion of 15,000 cu. ft. of water per second from the river, and after this quantity of water has been in use for a period of six months and it is found that no injurious effects on the falls are developed, he may grant additional revocable permits, the original amount of 15,600 cu. ft., however, to be given to companies now using the water. The Secretary is also authorized by the bill to issue permits allowing the transmission of 160,000 hp from Canada, and he may after issue revocable permits bringing the amount transmitted up to 350,000 hp.

The Lockport interests heard at the hearing asked for only 500 cu. ft. per second from the upper level of the Erie Canal. The Albion interest was small, as were also those of the Woodford estate and of Hon. Peter A. Porter. The principal interest was centered in the request of the Niagara Falls Power Company and of the Niagara Falls Hydraulic Power & Manufacturing Company, for these companies are the two concerns that come under the Burton bill as being actual users of the water at this time. Through its attorneys, Hon. John G. Milburn, of New York, and John L. Romer, of Buffalo, the Niagara Falls Hydraulic Power & Manufacturing Company asked a grant for 6,400 cu. ft. of water per second, stating this quantity is necessary to supply its present development and to provide for contracts already made. The Niagara Falls Power Company applied through Francis Lynde Stetson, of New York, and F. L. Lovelace, of Niagara Falls, for 8,600 cu. ft. per second, the quantity now diverted by the company. The total of these two applications is 15,000 cu. ft. per second, or only 600 cu. ft. less than the Secretary is authorized to issue original permits for.

Mr. J. M. Hansen, of New York, representing the Niagara County Irrigation & Water Supply Company, known also as the Love scheme, and the General Electric Company, asked that his company be permitted to divert 17,000 cu. ft. per second by means of a canal, starting from the upper river at La Salle and extending to the Devil's Hole in the town of Lewiston. The Niagara Gorge Power Company, through Herbert P. Bissell, of Buffalo, asked to divert 10,700 cu. ft. per second from the lower river, returning the water to the same stream or section of the river. As these two companies are not now using the water, they will come under that section of the bill which provides for revocable permits after the original 15,600 cu. ft. per second has been in use six months.

The Secretary received applications for permission to transmit 293,500 hp from Canada to the United States. These applications came from the Canadian Niagara Power Company, the Niagara, Lockport & Ontario Power Company, the Niagara Falls Transmission Company and the International Railway Company. The railway company last mentioned desires to be in position to transmit power from a station in Victoria Park to Niagara Falls, N. Y., for the operation of its lines in that city, the amount not to be over 3,000 hp. The Canadian Niagara Power Company is allied to the Niagara Falls Power Company. The stations of these two companies are connected by cable by way of the upper steel arch bridge at Niagara, and the company is erecting towers at Buffalo for a new transmission line to that city, the same to be run up the Canadian side of the river. The Niagara, Lockport & Ontario Power Company will distribute power generated by the Ontario Power Company, supplying Rochester, Syracuse and other places in western New York. The Niagara Falls Transmission Company will distribute power developed by the Electrical Development Company, supplying western New York places in very large number.

J. Horace MacFarland, president of the American Civic Association, spoke at the hearing, directing his remarks principally against the alleged waste of water, and asking that the importance of power be restricted.

British Reception of Electrical Engineering Societies.

Representatives of various national electrical engineering societies have visited England as the guests of the English Institution of Electrical Engineers. The numbers who actually responded to the courteous invitation of the British Institution are as follows: German, 71; Italian, 41; French, 17; Swiss, 14; American, 14.

All these visitors met in London at the Central Committee rooms and temporary headquarters of the English Institution in the Hotel Cecil on Saturday and Sunday, June 23 and 24 for registration.

On Monday, June 25, a special train conveyed them from Waterloo station to Teddington to be present at the ceremony of the opening of the National Physical Laboratory by Mr. Haldane, M. P., Secretary of State for War. On reaching Teddington station the party were taken in motor busses to the National Physical Laboratory in Bushey Park. The opening ceremony was presided over by Lord Rayleigh and among other notable personages present were the Earl of Rosse, Lord Kelvin, Lord Blythswood, Sir William White, Sir William Huggins, Sir A. Rucker, Sir Owen Roberts, Sir William Lee-Warner, Sir Philip Magnus, Sir A. Geikie, Sir J. Burt and Mr. Yarrow.

Dr. Glazebrook, Director of the Laboratory, having made a brief statement, Mr. Haldane, in an interesting speech, declared the building open. He traced the development of Germany's prominence in applied science, and referring to the English ability for sudden effort, expressed the hope that the opening of this institution was a sign of British determination to push rapidly to the forefront in these matters. He expressed pleasure at the large number of distinguished foreign scientists present and made courteous reference to the branches of science most strongly developed by them respectively.

A vote of thanks was proposed by Sir John Wolfe Barry, seconded by Sir John Brunner and carried with acclamation. After the ceremony the guests dispersed for refreshment and to visit the various departments of the laboratory where members of the staff were busily engaged in demonstrating and explaining the apparatus. The faces of scientists and electrical men well known to American engineers were to be seen on all sides and the various engineering professors, among them Professors Perry and S. P. Thompson were seen busily engaged assisting the staff in their explanations.

Refreshments were served on the lawn and several members of the party returned to the station through Bushey Park. The American members mentioned above were all present.

The same evening on the return of the party to London a banquet was given at the Hotel Cecil in honor of the visit of the kindred institutions from abroad. The guests numbered over 500 and a most distinguished and representative gathering of men of pure and applied science were present.

The guests included: The Rt. Hon. Lord Kelvin and Lady Kelvin, the Rt. Hon. Lord Suffield, Sir. W. and Lady White, Sir Alexander and Lady Binney, Sir William and Lady Ramsay, Sir H. and Lady Mance, Sir J. W. and Lady Swan, Sir Charles and Lady Owen, Sir W. and Lady Crooks, the Rt. Hon. Sidney Buxton,, M. P., Postmaster-General; Mons. Auzepy, Consul-General of France; Commendatore L. Allatini, Consul-General of Italy; the Presidents and Secretaries of all the visiting Societies with the exception of President Jona, of Italy, who was represented by Secretary Guido Semenza.

After the usual toasts, the toast of the visiting delegates was proposed by the Rt. Hon. Sidney Buxton, M. P., and replies were made by Prof. J. L. Farny, representing the Association Suisse

des Electriciens; Mr. P. J. Auzepy, Dr. E. Budde, of Germany; Dr. Emil Naglo, Dr. S. S. Wheeler, President of the American Institute of Electrical Engineers, and Mr. G. Semenza, who presented a beautiful bronze bust of Volta to the English Institution on behalf of the Italian Society.

After dinner a reception was held at which almost the entire number remained to a very late hour greeting various colleagues and friends from abroad, the opportunities of meeting whom was one of the most interesting and delightful features of such an entertainment.

The following day, Tuesday, June 26, the combined parties met at the Hotel Cecil and divided into five groups to visit the various places of interest, the parties being conveyed in special motor busses of the type that is now so largely used in the city of London. After the morning visits, half the party met for luncheon at the Ship Hotel, Greenwich, and the other half at the Earl's Court Exhibition, where luncheon was served at the Welcome Club. The parties then separated to visit other features of interest in the neighborhood.

In the evening a reception and conversazione was held by the President, the President-elect and members of the Council of the Institution of Electrical Engineers in the Natural History Museum, South Kensington, when upwards of a thousand guests were present and another opportunity was afforded for meeting and welcoming old friends.

During Tuesday, while the gentlemen were inspecting factories, power stations, etc., the ladies were taken in motor cars round London to the chief places of interest, afterwards meeting the gentlemen for luncheon and at the reception. Throughout these events the cordiality and generosity of the reception accorded to the foreign delegates has been a matter of continuous comment, and it is certain that the English Institution is endeavoring, not only to repay the courtesies received by its members when abroad, but is succeeding in establishing a record not simply for the magnificence of its welcome, but for the elaborate care and forethought noticeable in all arrangements.

Wednesday, June 27, the party assembled at the Hotel Cecil in the early morning and departed for an excursion to Windsor where luncheon was served at the White Hart Hotel and a trip taken up the Thames to Cookham, returning to London in the evening.

TOUR THROUGH GREAT BRITAIN.

The reception of the foreign engineering societies during their tour through the manufacturing towns of England, after their stay in London, was marked throughout by the utmost cordiality and in the magnificent and extensive preparations made everywhere for their reception there was shown not only the hospitality of a great nation, but the desire to outdo the kindness shown to the English society in its previous visits to other countries.

The reception by the Lord Mayors of Birmingham and Manchester, the Mayor of Salford, the Lord Mayor of Liverpool and by the Lord Provost of Glasgow were but a few of the interesting features of the visit. Especial interest, however, focuses on the gathering which assembled at the University of Glasgow on Monday, July the 2d, by invitation of the Rt. Hon. Lord Kelvin, Chancellor of the University and chairman of the local section of the Institution of Electrical Engineers. The visitors assembled in the famous Bute Hall and the function was attended by a distinguished company. An incident of special interest was the ceremony of the presentation to Lord Kelvin on behalf of the Italian section, of two magnificent portfolios of reproductions of old drawings of mathematical and mechanical subjects by the great and many-sided Italian, Leonardo Da Vinci.

The presentation was made by Signor Guido Semenza, secretary of the Associazione Elettrotecnica Italiana, in a small room in the presence of about 40 members of the Italian party and a few of the more distinguished members of the other societies. After the presentation speech by Senor Semenza, Professor Pagliani, of the University of Palermo, read the address.

Lord Kelvin, in acknowledging the presentation, traced the progress of Italy from the days of the great Leonardo Da Vinci and referred with the utmost pleasure to the great prominence now occupied by Italian engineering, and trusted that the present made to him and the beautiful bust of Volta, which was presented to the English Institution exactly a week previously in London, would form the basis for a perpetual bond of friendship between Italian and English engineers. At the conclusion of this ceremony the room was thrown open and the hundreds of visitors present at the gathering passed through to examine the two enormous and beautiful volumes of reproductions of Da Vinci's manuscripts.

The tour of the combined societies through English manufacturing towns commenced June 28. The party passed from London to Rugby, Birmingham, Manchester, Liverpool, Glasgow, Edinburgh, Newcastle-on-Tyne, Leeds and back to London. More than 200 members traveled on the special train which carried them through the tour and the large number of engineers, scientists, municipal authorities and friends who met them at each stopping place, frequently swelled the total to nearly 500 persons.

In the following descriptive notes attention is called to the things seen on this tour of most interest to American engineers, either as outlining present British practice in electrical engineering or as being actually new and therefore of timely importance to the engineering world at large.

Rugby.

After the start of the special train from London containing the members of the visiting engineering societies, the first stop was at Rugby, where visits were paid to Messrs. Willans & Robinson's factory and also to the works of the British Thomson-Houston.

At the former factory several points of interest were shown to the visitors. The turbines for the Cunard liner were in course of construction, the blades for the low-pressure stage of which are two feet long and two inches wide. Other turbine work of interest was in process of construction, including a number of 3,000-kw sets, operating at 750 r.p.m., 180 lb. pressure and 100° superheat, three of which are for the Glasgow Corporation, two for the St. Andrew's Cross and one for the Port Dundass Station, two for Leeds and one for the Lancashire & Yorkshire Railway Company. These six sets, which represent the latest practice of Messrs. Willans & Robinson, employ definite ventilation of the generators. For the bearings oil under pressure is supplied to the center and carried along the surface by one longitudinal groove. The by-pass is arranged for automatic operation from the governor when the throttle is fully opened. The casing is built up in several pieces and the high-pressure end is mounted on a machined surface, which allows sufficient motion to take care of the expansion due to change in temperature. The balance pipes are taken out from an intermediate stage and run separately through an expansion joint to the balance rings, no longer forming part of the main casting as in former machines.

A large amount of castings in aluminum and phosphor-bronze for motor car work were being made, which work is rapidly becoming very important. Visitors were shown the well-known cylinder test of which this company are justly proud. A cylinder was taken from stock and the gauge plug inserted, the whole being then placed on a steel plate by a rope attached to the plug, the whole mass, including two men standing on the plate, then being raised from the ground.

In the testing department vibration tachometers are used for determining the speed of the turbine under test. These are found very useful as they can be placed in any convenient position near the turbine and no mechanical connector need be used, the vibration of the surrounding room, though extremely slight, being quite sufficient for satisfactory operation.

Birmingham.

After the lunch provided by the Lord Mayor of Birmingham the party visited the works of the General Electric Company, at Witton, where a great many interesting machines were seen in course of construction. Among others this company is now building a 2,000-kw, 3,000-volt alternator for Dublin, two 1,000-kw, three-phase, 3,000-volt alternators for Cardiff, ten motor-generator sets for Manchester Corporation and a large variety of smaller work.

The third order of 100 30-hp, 460-volt motors for the London Underground Railway were shown in construction, and the arrangement of field coils at once attracted attention. This ar-

rangement is the usual one adopted by this company, which standardizes the field spools in sections. The given design calls for 1, 2 or 3 sections which are taken out of stock, placed on the poles and clamped together.

The cheap method of construction of the commutating poles employed by this company on nearly all its machines is of interest. This interpole consists apparently of a thin pole face supported at one end by a rod. The copper spool is placed round this rod, thus saving in the neighborhood of 60 per cent of the copper required for the commutating poles. This commutating pole is not quite the same length as the main poles; a small space at the tip is occupied by a copper bar thrown across between the tips of the main poles to act as a damping shoe. In all the direct-current machinery shown the endless bar armature winding construction is used.

This company is also building large numbers of induction motors with wound rotors for mining work. These are started in the usual way by means of resistance inserted in the rotor winding through slip rings. To prevent accident, however, due to sparks from these collector rings when starting through setting fire to inflammable gases, a special box cover is mounted on the end of the bearing entirely enclosing the slip rings and the end of the shaft. The leads are brought in through the side of this box and a small window of mica is provided for inspection of the brushes.

Adjoining the engineering shops at Witton are also situated the large carbon works. These comprise two buildings thoroughly equipped with up-to-date machinery and are the only carbon works in England.

The raw material used for the manufacture of carbon consists of gas retort carbon, soot and tar. The retort carbon as received from the gas works has to be carefully selected and cleaned before use, and is then ground to a fine powder by rolling mills. The soot has to be specially manufactured and requires to be of a certain definite physical constitution. The same also applies to the tar, and in order to manufacture a high-grade carbon very careful control is maintained of all the raw material used. The ingredients are carefully mixed in a large steam heating machine and the mixture passed to the stampers, in which it is stamped into solid blocks of a size suitable for use in the hydraulic press, where it is forced through steel dials of the required diameter. The rods so formed are then baked for approximately one week, the temperature being increased and decreased through a large number of ovens, the rods remaining in each oven for half a day. The maximum temperature of between 1,400 and 1,500° C. is reached on the third day. After this process the rods are cut to the required length, sorted for straightness and the ends ground.

A large laboratory is used by this company for experiments with various combinations of carbon and for experiments to determine the length of life, quantity of ash produced, etc.

Manchester.

On Friday morning, June 29, after a reception by the Lord Mayor of Manchester, a visit was paid to the Dickenson Street Station of the Manchester Corporation Electricity Works. This plant is of much interest, since it contains machines of various periods, down to the three new La Cour converters and also two new Parsons turbo-generators. The converters are arranged for operation on either the 400-volt or the 550-volt, direct-current buses with an output of 1,200 amp. and 900 amp., respectively. The normal speed of the sets is 428 r.p.m. and the alternating-current end is wound for 6,500 volts three-phase, 50 cycles. All three of these converters were operating at an overload of about 10 per cent at the time of the visit with very slight heating and excellent commutation. The engineer in charge of this station stated that exceedingly heavy loads do not pull these machines out of step and expressed great satisfaction with their operation. It is interesting to note that more than 20 different employes have synchronized these machines during the few months of their operation, many of whom were inexperienced men. The average time for synchronizing is stated to be 1 minute 40 seconds, which thus compares favorably with a rotary converter.

Two field windings are provided and on lighting loads (400 volts) the machine operates shunt wound while on traction loads (550 volts) a series field is connected in. The box containing the starting resistance stands beside each machine and is about 3½ ft. by 2½ ft., having mounted on the top a starting switch and synchronizing voltmeter, which must indicate zero volts when the machine is thrown on to the continuous-current buses. The starting is done from the alternating-current end by means of resistance inserted into the rotor winding, which is brought out through slip rings. Ten more sets similar to those now installed are on order.

The switching arrangements for these sets are as follows: Panel for the alternating-end of each set, containing a wattmeter, ammeter, power factor meter, time-limit relay and high-tension oil switch. For the direct-current end each panel mounts two recording wattmeters and one ammeter, while two voltmeters, one for the buses and one for the machines, are mounted on brackets at the end of the board. This switchboard apparatus was supplied by the British Westinghouse Company, and the converters by the Bruce-Peebles Company, of Edinburgh.

This station also contains two 750-kw Parsons-Siemens machines of very recent design, operating at 1,600 r.p.m., and wound for either 400 or 500 volts. They have four poles and are provided with auxiliary commutating poles. The field winding is so arranged that the machine will operate as a lighting generator, shunt-wound, and as a traction generator, compound-wound. The rating is for an output of 1,670 to 1,870 amp. at 400 to 450 volts, and as compound machines from 0 to 360 amp. at 500 to 550 volts.

The auxiliary poles belong to an entirely distinct magnetic system comprising a separate yoke and four poles. This yoke is made up in two rings, rather less in diameter than the main yoke; the poles, which have the same length along the axis of the machines as the main poles and are laminated, project into the space between the main poles. They are excited by a winding in series with the armature so designed as to give a field of correct strength for commutation. The commutation magnetic system is not saturated, and therefore the flux is practically proportional to the load on the machine; it is stated that no change in position of brushes is required for varying loads.

A "diverter" is provided in parallel with this winding by means of which the proportion of the main current flowing round the commutation poles can be shunted. It also serves to render the change of flux in the commutation magnetic system extremely rapid, acting on the well-known principle of a large inductance shunting a smaller one. This "diverter" stands beside the turbo-generator, and is about 3 ft. in height, being similar in appearance to a transformer. It is provided on the top with an adjustable air-gap for varying the inductance and in front with a large copper revolving switch with several studs which serves to vary the number of turns used, the studs being connected to taps in the winding. It is not covered with a cast-iron case, but simply placed in a light open frame. The commutator is approximately 3 ft. long and has 5 shrink rings in all. Carbon brushes are used and ebonite protection pieces are fixed in the space between the revolving shrink rings.

After the luncheon at the Town Hall, Manchester, given by the Lord Mayor of Manchester, the Mayor of Salford and the Electricity Committees of Manchester and Salford, a visit was paid to the works of the British Westinghouse Electric & Manufacturing Company, Ltd., at Trafford Park. Among the most interesting things shown were the new Westinghouse turbo-generator sets, of which a large number are on order for various parts of England.

The direct-current turbo-generators are built with interpoles having laminated slotted pole faces, and in addition have a compensating winding and provided with copper brushes having carbon tips.

An interesting three-phase, 300-kw, 3,000-r.p.m. turbo-generator wound for 500 volts was also shown. This machine, which was designed by Mr. Miles Walker, is excited from a small unipolar exciter mounted on the end of the shaft outside, the normal output being from 60 to 70 amp. at 20 volts. The leads from this exciter pass inside the shaft through the main bearing of the generator and out again into the revolving field of the alternator. In the control department a large number of men were employed, since this department has recently received several large orders, among them one for 150 complete equipments of

motors and controllers for the London County Council Tramways and 200 complete equipments for the La Croze Tramways. Visitors were also taken on the new Westinghouse single-phase car, running on an experimental track outside the Manchester Works. The car is equipped with four 100-hp, single-phase motors. The trolley pressure was 3,300 volts, 25 cycles, the current being taken from the overhead wire by a pantograph collector similar to that installed in the Exhibition Railway in Milan, Italy, by Dr. Finzi. The car carries an air-cooled transformer and two master controllers operating an electromagnetic unit switch main controller, etc., etc. The weight of the electric equipment is 23,500 lb., of the air-pressure equipment 1,350 lb. and of the full car 80,500 lb. The car has seating capacity for forty-eight passengers. This motor is rated 45 hp for continuous operation on a 25-cycle, 200-volt. At this rating the power factor is 96 per cent. The normal rating of the motor is 100 hp for one hour, 225 volts, 25 cycles. The power factor with this rating is 88 per cent and a temperature rise of 75° C. is guaranteed.

The Denver "Welcome" Arch.

In our issue of July 7 we gave a brief illustrated description of the handsome "Welcome" arch just erected at Denver. Mr. Frank Farrar, of the Denver Gas & Electric Company, sends us a few further details.

The "Welcome" arch is made after a design chosen from a number entered in a competition, and is that of a Denver resident. It is entirely a home product in construction, and the iron works that obtained the contract found it necessary to make extensive additions to its plant, in order to carry out the scheme.

The arch is of cast iron, and is anchored deep in a bed of

DENVER "WELCOME" ARCH ILLUMINATED.

concrete. All of the iron work is duplex plated, giving it an antique appearance. Including the word "Welcome," which is permanent, there are 1,325 4-cp lamps. A changeable electric sign, on which will be placed the name or initials of any organization that may be holding a convention, will require a varying number of lamps. Only incandescent lamps will be used.

Both sides of the arch are completely outlined, including the scrollwork. All feed wires are in conduits, and wherever possible the wiring is concealed in holes left in the ironwork in casting. On the leaves and other ornamental portions lead cable is used for the wiring, practically concealing it.

The arch will be lighted every night, and arrangements are being made to use colored lamps on special occasions. The first convention that will be welcomed is the Elks, the middle of July.

The "Welcome Arch," which stands at the Union Depot in Denver, was dedicated before ten thousand people on July 4. The Mayor accepted the arch on behalf of the city in a speech that emphasized the value of lights as a welcome to strangers. The arch weighs seventy tons, is 60 ft. high, and the driveway is 34 ft. wide. The cost of the arch was $22,000, which was raised by public subscription. It will be noted that a small unit lamp is found sufficiently effective, and, indeed, best for the purpose, so that the consumption of electrical energy is kept down to a very economical point.

Single-Phase Railway for Anderson, S. C.

The Anderson Traction Company, of Anderson, South Carolina, is now actively engaged in building the first section of an interurban road which will eventually connect the city with Greenville, 35 miles away. Anderson is the center of the cotton mill district in the South and the new line will place it in touch with the surrounding cotton mill towns as well as in closer connection with the main line of the Southern Railway. In the city there is already a direct-current railway and the first branch of the interurban is a continuation of the present lines as far as Belton, a distance of ten miles. Complete station apparatus and motor equipments for single-phase operation have been ordered for the extension. The new cars are of the heavy interurban type and are each equipped with four 75-hp, single-phase motors, adapted for operation at 3,300 volts alternating current on the interurban section of the road and at 550 volts direct current on the present direct-current city lines. Each car is fitted with air brakes, for which the motor compressors are adapted for operation on either direct or alternating current, this apparatus as well as the car motors and equipment being furnished by the General Electric Company.

Power for the operation of this road will be purchased from the Savannah River Power Company, delivered at a sub-station in Anderson at 66⅔ cycles. In the sub-station there will be a three-unit motor-generator set, consisting of an induction motor driver, direct-connected to an alternating-current generator for the single-phase portion of the line and a direct-current machine to supply the present city line. The driving motor consists of a two-phase, 66⅔-cycle, 1,150-volt induction motor, receiving its current from the 66⅔-cycle supply above mentioned. Direct-connected to this is a 300-kw, 25-cycle, single-phase, 3,300-volt, alternating-current generator which will furnish the ten-mile single-phase section now under construction with current directly to the trolley at 3,300 volts, without sub-stations. The remaining machine for furnishing the direct current consists of a 250-kw, 600-volt railway generator, complete, with an exciter on the same shaft as the other three machines.

The officers of the Anderson Traction Company are: Mr. J. A. Brock, president; Mr. F. G. Brown, vice-president; Dr. Geo. E. Coughlin, general manager. The road is being constructed under the direction of Mr. J. E. Sirrine, engineer, of Greenville, S. C., with Mr. E. F. Lilly, of Columbia, as consulting electrical engineer.

CURRENT NEWS AND NOTES.

A PRIZE NAME.—At Syracuse, N. Y., the Central New York Telephone & Telegraph Company is organizing a name contest, with cash prizes for the best name to be given its new telephone exchange.

TELEPHONE ROOF GARDEN.—It is proposed to provide for the girls operating the Bell telephone system in Boston a roof garden, as a supplement to the present facilities furnished to them for rest and comfort.

EDISON ILLUMINATING ASSOCIATION.—The Association of Edison Illuminating Companies will hold its annual convention at the Hotel Frontenac, St. Lawrence River, September 4, 5 and 6, under the presidency of Mr. J. B. McCall, of Philadelphia. The Association has already visited the Frontenac and found it a charming resort for convention purposes.

BLACK SANDS.—The investigation of the black sands of the Pacific Coast, which has been carried on for over a year by the United States Geological Survey, at Portland, Ore., as already noted in these columns, will be continued until the first of September. After that the plant will be transferred to Chapel Hill, N. C., where a similar work will be carried on in connection with the Geological Survey of the State. It is believed that the sands of the eastern coast will be found as rich in valuable and rare minerals as concentration experiments have shown those of the Pacific slope to be.

TELEPHONY IN NEW YORK.—The New York Telephone Company offers in return for a monopoly of the telephone business in New York City to furnish telephones for the city departments 50 per cent less than regular cost. It also offers to pay the city $116,000 for the first year, increasing this during six years until the amount shall be $200,000, continuing at that figure thereafter.

TELEPHONY IN CUBA.—It is reported from London that a prominent London banking house has announced the purchase of a controlling interest in the Cuban Telephone & Telegraph Company and the Red Telefonica Company of Havana. It is proposed to reorganize them under the title of the Havana Telephone Company. The board of English directors headed by Lord Elcho will continue in control.

HONORS TO THE CURIES.—A special dispatch from Paris of July 14 says: "Mme. Curie, who was made professor at the Sorbonne in the place of her late husband, has shown a touching desire to adhere to all his wishes. She has just written to the newspapers asking the women of France not to hold the demonstration they were preparing in honor of herself and the dead M. Curie. "I cannot forget that M. Curie did not approve of the commemoration of the dead by statues or otherwise," she says, "and I naturally desire to respect his wishes.'"

TELEGRAPHY IN THIBET.—Since the British-Thibetan treaty was made, the Indian Government is trying to open up the "Hermit" country to civilization and commerce. The latest news to hand is that the assistant commissioner at Kulu is proceeding to Gartok during the present month to inquire into trade matters. Under the agreement with China regarding Thibet the right to connect the trade marts with the Indian telegraph system has been recognized, so it may fairly be said that the opening up of trade between the two countries in this hitherto unexploited region commences under very encouraging auspices.

TELEPHONY IN CHICAGO.—The Illinois Manufacturers' Association has submitted to Mayor Dunne their proposition for a second telephone system in Chicago. Business telephones will cost no more than $90 for a single wire service, and as low as $15 for party lines. Residence connections will not cost more than $60, or $50 for single lines, and as low as $15 for party connections. The city is given 25 per cent of the gross receipts of the company each year, and is offered the right to purchase the plant at any time at its tangible value plus 5 per cent. The company promises to have 25,000 telephones in operation by 1909 and 50,000 in the following year.

ELECTRICITY AND MOSQUITOES.—In his youth, Edison made short work of cockroaches in his telegraph office by electrocuting them, with a "short" of their own. A special cable dispatch from Paris, of July 14, says: "M. Maurice Chaulin has declared war electrically on mosquitoes and gnats. A cylindrical lantern is constructed of two rings suspended one above the other and connected by parallel and vertical chains. These are connected with the source of electricity in such a fashion that each of the chains is always alive. In the center is a lamp. Electric or other light attracts mosquitoes, which begin to buzz around the lamp and come into contact with the chains. The moment an insect touches two at once with its legs it establishes a short circuit and is immediately electrocuted."

THE QUESTION BOX.—Secretary W. C. L. Eglin, of the National Electric Light Association, states that the value central station men place upon the convention papers of the National Electric Light Association is strongly evidenced by the large number of orders sent in for sets of these papers and the "Question Box." The programme of papers is now so large and the expense of printing so heavy, it is found impracticable to make free distribution of the papers, before they are issued in book form, except to members attending the meetings. Although the transactions are distributed as promptly as the character of the publication will allow, a large proportion of the members are glad to pay the cost of printing and mailing in order to have loose copies of the papers at once, and the secretary's office has been kept busy filling orders for them.

LIGHTING IN NEW ENGLAND.—The summer meeting of the Association of Electric Lighting Engineers of New England will be held at the Memorial Hall, Springfield, Mass., on Thursday, July 26, at 11.30 a. m. The circular of notification, issued by Mr. W. L. Mulligan, manager of the United Electric Light Company, of Springfield, states that the plants of that company will be made the subject of special attention and visit. The company has recently installed three 100-kw steam turbines in the space occupied formerly by a 350-hp and a 500-hp engine, and it is believed that the present arrangement will be of great interest to the members. The company is now operating two hydraulic plants and one steam plant, which generate electrical energy at 5,500 volts, two-phase, 60 cycles, and are connected together by transmission lines, part of which are overhead and part underground.

BRITISH ELECTRICAL ENGINEERS.—Dr. R. T. Glazebrook, director of the National Physical Laboratory of England, is president-elect of the Institution of Electrical Engineers of England. He is well known to Americans and was one of the visitors to this country in 1904, participating in the St. Louis Congress trip. He is a typical all-round Englishman, a lover of sport, a mountain climber, and best of all an enthusiastic physicist. He was born in 1854, is a graduate and wrangler of Cambridge University, and is fellow of Trinity College. Beginning his life work under Clerk Maxwell, he became demonstrator at the Cavendish Laboratory in 1880, and later assistant director; and in 1898 was made principal of University College, Liverpool. He became director of the National Laboratory in 1900. He has been a fellow of the Royal Society since 1882, and was president of the Physical Society in 1904.

NEW UNDERGROUND WORK.—The city of Toledo, O., is adopting a new ordinance to regulate wires and place more of them underground, and is creating a supervisor of wiring at a salary of $1,800 a year. At Portland, Ore., all the wires and cables of the Portland General Electric Company are to be placed underground in the near future. Engineers of the corporation are now preparing plans for the proposed underground conduit system, which will be presented to the City Council within the next 60 days. It is proposed that these plans, if acceptable, will be incorporated in an ordinance which will affect all electric light and power companies operating in the city. It is estimated that the outlay for placing the wires underground will be not less than $500,000. The franchise of the corporation does not call for placing the wires underground, but in order to keep pace with the times and to protect the business interests of the city the corporation has decided to make the change.

CHICAGO EDISON OFFERS TO OPEN BOOKS.—The Chicago Edison Company and the Commonwealth Electric Company have offered to open their books to an examination by a committee of Chicago business men consisting of Victor F. Lawson, a prominent newspaper publisher, James R. Forgan, President of the First National Bank, and Bion J. Arnold, consulting engineer; this committee to determine from this examination whether the rates charged are not reasonable. Chicago city officials and politicians, not being satisfied with the recent reduction in rates by the central station companies, have been asking for an examination of the companies' books. On account, it is stated, of the conspicuous lack of fairness with which this whole subject has been treated by Mayor Dunne and his associates in the Chicago City Hall, and on account of the misstatements and misrepresentations for which these gentlemen are responsible in connection with the recently defeated ordinance on rate regulation, the attorney for the companies refuse to allow the examination of the books to be made by such prejudiced persons, not believing that any conclusions they might draw from the examination would be fair.

ELECTRIC HEATING AT BILTMORE.—It is stated that Mr. George W. Vanderbilt, who has a fine country seat at Biltmore, North Carolina, is to make some experiments in heating the water supply of the place with electrical energy from a plant 10 miles away. The results will be interesting, but it is hardly to be expected that any special economies will develop.

THE GREAT AND GOOD GIANT OF FISK STREET.—Under the foregoing title the *Electric City*, published by the central station companies of Chicago, is running a serial article on the mammoth Fisk Street power house of the Commonwealth Electric Company, where the famous 7,000-kw steam turbines are installed. That the giant is great none can deny and that he is furthermore good the neighbors of smoke belching isolated plants that he has put out of business will all agree.

THE CHARM OF CIVILITY.—President J. L. Richards, of the Boston (Mass.) Consolidated Gas Company, has issued a circular to the employes of the company, urging the necessity of cultivating various virtues in dealing with the public. The circular says: "Exercise politeness and courtesy at all times. Never lose your temper or allow any personal feeling to interfere with the proper discharge of your duties. Avoid in manner and word any trace of officious importance when carrying out the company's orders. Don't make promises the company cannot fulfill. Above all, don't misrepresent in any particular the true condition of any transaction. Keep your personal appearance up to the mark. Walk smartly and avoid slouching." Some electric light companies might take a leaf out of the Rich Richards' book of wisdom.

THE CONTEMPTUOUS DOHERTY.—Last month we noted the fact that Mr. Henry L. Doherty, president of the Denver Gas & Electric Company, had been ordered under arrest in Denver for contempt of court by Judge Johnson, but was excused from actually doing so by a supreme court order. On July 2 the State Supreme Court, through Chief Justice Gabbert, decided that the local district court had exceeded its jurisdiction in interfering in election matters, for this is properly vested in the State Supreme Court. The acts of Judges Johnson and Mullen are, therefore, subject to review and Mr. Doherty need not go to jail nor pay fine. It will be remembered that the culprit advised the court that he held it not merely in contempt, but in perfect contempt, for trying to make answer in a case that was utterly beyond its ability and jurisdiction, and which was irregular in other ways.

MACKAY ENGINEERING GIFT.—At the meeting of the Finance Committee of the Board of Regents of the University of California on July 11 President Wheeler transferred to it $100,000 which had been placed in his hands by Clarence H. Mackay for the foundation of a John W. Mackay, Jr., Professorship of Electrical Engineering in memory of his brother. Clarence H. Mackay and Mrs. John W. Mackay share equally in the gift. Prof. C. L. Cory, head of the department of mechanical and electrical engineering, is to fill the chair. This bequest is a sequel to the offer of $100,000 toward the rebuilding of the university telegraphed to President Wheeler by Mr. Mackay a few days after the earthquake. The annual income from the money will be applied to the payment of a professor's salary, and the expenses and maintenance of the department, the original fund to be kept intact in perpetuity. It will be remembered that a few months ago Mr. Clarence Mackay gave $5,000 to the land fund of the American Institute of Electrical Engineers, for the land on which the United Engineering Building stands.

LAKE NEMI WATER POWER.—One of the pleasure resorts of the old Roman Emperors was Lake Nemi, on whose water floated magnificent galleys belonging to Caligula and Tiberius. These galleys went to the bottom of the lake, and many efforts have been made to recover them and their art treasures. Such efforts have hitherto been fruitless, but the relics secured by diving have encouraged more ambitious attempts. Malfatti has suggested the draining of the entire lake by means of a tunnel. Prof. Giura, however, has suggested the use of the old Roman outlet. According to Malfatti's scheme, the valley of Ariccia would be partially flooded. According to Giuria's scheme, the water will be piped across the valley of Ariccia, and will be made to drive an electric plant. If the bottom of the lake is ever exposed, the bodily removal of the two old galleys will present considerable difficulty. Prof. Giuria has suggested the use of iron cradles built around the barges, upon which cradles the barges will be pulled out upon tracks, for which purpose some of the electrical energy could be used.

THE OWNERSHIP INQUIRY.—Mr. Melville E. Ingalls, president of the National Civic Federation, who, with the commission appointed to study the question of Municipal Ownership in Europe returned to New York last week. Interviewed, he said: "The report of the commission will not be made public until the end of October. We have still much to do in completing our investigations here in America and comparing our individual observation before our final report. It would be premature for me to express an opinion on the relative advantages or disadvantages of municipal ownership before our investigations are complete. We studied the question solely with the idea of its adaptability here in America. There is a great deal that can be said pro and con. In many cities, such as Glasgow, Manchester and Liverpool, the system works admirably, and is looked upon generally by the citizens as a public benefit. In Glasgow especially James Dalrymple, manager of the Glasgow Municipal Tramways has done much to prove municipal ownership undoubtedly successful to that city. In many other cities we found the idea met with considerable public endorsement. The same cannot be said of London, however. There, public sentiment is against it, although such men as John Burns are strong advocates. I consider that our trip has been most satisfactory, and we have learned a good deal that will be of interest to the American public. In Europe we confined ourselves principally to the study of the question of municipal ownership obtaining in Great Britain. We met with a cordial reception everywhere, and found the authorities very willing to facilitate our work."

MUNICIPAL OWNERSHIP IN WISCONSIN.—Statistics have just been compiled on the municipal ownership of electric light plants by Edward Bradford Smith, for the legislative reference department of the Wisconsin Free Library Commission. Mr. Smith is a graduate of the University of Wisconsin in the class of 1897, and during the past year he has been research scholar in political science in the university. His study of the electric light problem was made in direct response to letters received by the legislative reference department from city officials and legislators, asking "What cities have municipal electric light plants?" "How many exist in Wisconsin?" "How many are there in America?" Similar questions are being asked with regard to gas plants, and the departments will soon be able to furnish full information on that subject also. The first municipal electric light plant in Wisconsin was established at Bayfield in 1889, five years after the beginning of the electric lighting business in this State. At that time there were 30 private plants in operation. The latest figures, those of last March, show 46 municipal and 123 private plants in the State. Of the 123 private plants 35 are in places of less than 1,000 population, which is true, also of 13 of the 46 municipal plants. The cities and villages of the State having municipal plants are as follows: Bayfield, Columbus, Fort Atkinson, Marshfield, Mazomanie, New London, Oconomowoc, Plymouth, Reedsburg, Stoughton, Two Rivers, Algoma, Arcadia, Warron, Black River Falls, Blair, Blanchardville, Boscobel, Cedarburg, Clintonville, Elroy, Colby, Cumberland, Elkhorn, Evansville, Fennimore, Florence, Grantsburg, Rice Lake, Greenwood, Independence, Hudson, Jefferson, Kilbourn, Monticello, New Glarus, Princeton, Richland Center, River Falls, Sauk City, Shawano, Spring Green, Sturgeon Bay, Thorp, Whitehall, Waupun. Of these the first eleven have the electric light plant operated in connection with the municipal water works. Only one plant, that in Hudson, is leased to a private company. It would appear that a very large proportion of the plants are in places where the inducement of possible profit is far too small to invite private enterprise.

THE SUPERFLUOUS NIGHT.—New York City has recently seen put in operation a bank that is open all night, as well as all day. London now has a dry goods retail establishment which announces that it will receive orders made personally or by telephone at any hour of the twenty-four. It is not explained why people should be likely to want dry goods in such a hurry.

INDIAN COTTON MILLS.—United States Consul W. T. Fee, in a letter from Bombay, notes the fact that a native cotton mill there, owned by the family of Sassoon, with 2,000 looms and weaving piece goods for the Indian and Chinese markets, has been running only 13 hours, in the daylight. It is now installing an electric light plant, which will increase its capacity of output considerably.

THURY SYSTEM.—The Thury patents dealing with the high-tension direct-current system of transmission have been purchased for England by Messrs. Dick, Kerr & Co. This is said to follow Mr. Thury's recent frequent visits to London in connection with the Zambesi power schemes commission and the consideration recently given by various engineers to schemes for power supply to London.

THE TELEPHONE IN LITERATURE.—In a recent article in the *Critic*, Mr. Andrew Lang calls attention to the function of the telephone in modern literature. Every observer of contemporary fiction has noted that the telephone has made a great difference in novels and plays. It has helped the development of plots and largely increased the efficacy of the long arm of coincidence. Mr. Lang points out that a good deal of the action and much of the conversation of "The Crimson Blind" are "transacted by telephone." The same is true of "The Wire Tappers." "The Crimson Blind" is the kind of book Mr. Lang reads himself to sleep with. Mr. Lang thinks that if Horace Walpole could have chatted with Mme. de Sévigné over the telephone, or Thackeray with Mrs. Brookfield, literature would have been poorer. In many modern plays the telephone is more prominent and effective than the leading actors.

FRENCH ENTERPRISE.—At the textile industries exposition at Tourcoing, France, the display of M. Burms-Demay, of that city, in the electrical section, is worthy of special mention. The exhibitor, who is a hardwareman, specializing on heating and ventilating appliances, electricity and ironwork, has taken as his text "Domestic Electricity," and fitted up his stand as the section of a three-story house. Upstairs is the bathroom, with the latest patterns in artistic electroliers, and a parlor chimney with handsome metal ornaments, smart brass fender and fire-irons and all accessories. In the basement is the kitchen (where one tiny motor suffices to work a meat chopper, a knife cleaner, a coffee mill and a freezer), and the heating apparatus is in the adjoining cellar. A small room has a sewing machine run by electricity, and all over the house are radiators, electric fittings, door furniture, and the hundred and one forms of builders' hardware. The novelty of the stand is that as the rooms are presented in a shallow section, a yard or two deep by a few yards high and wide, the spectator can take all in at a glance.

A "SCHOOL OF PRACTICE."—The Denver Gas & Electric Company has opened a "school of practice" in which twenty students who are graduates of Cornell, Wisconsin, Michigan, Massachusetts Technology, Dartmouth and Purdue will be taught with thoroughness every branch of the gas and electric business. The school is the idea of Mr. Henry L. Doherty, president of the Denver company. He is anxious to always have a supply of competent gas and electric men available for his many companies, and believes that his school will serve this purpose. The practical course will cover a period of two years. The men will go into each department and learn it thoroughly. Although they have all had courses in engineering, their training with the Denver company will not be entirely technical. They will be obliged to study the commercial side, so that they will have a complete knowledge of the best methods of selling gas and electricity. When these men have finished the course, they will be fitted for any position in connection with the gas and electric business and will be thoroughly versed in modern methods.

MONORAIL FOR BROOKLYN.—Mr. F. B. Behr, the inventor of the monorail system of rapid transit, has been agitating the need for it in Brooklyn. On July 9 representatives from various boards of trade and other civic organizations of Brooklyn, particularly of South Brooklyn, met in the rooms of the Brooklyn League and organized "The Real Rapid Transit Association of Brooklyn." Mr. Judson Wall was elected president. The tentative monorail route which was there laid out starts at the Williamsburg Bridge, goes through Williamsburg, Flatbush, Bensonhurst and to Coney Island, there making a loop and coming back through South Brooklyn, along Third Avenue to Flatbush and Atlantic Avenues, there connecting with the Interborough Subway, which is now building. The monorail system would be partly subway and partly elevated. Mr. Behr said the speed of the trains could be a mile a minute with safety. The new organization purposes to get the consent of 60 per cent of the property owners along the proposed route, lay the matter before the Rapid Transit Commission, and if possible get a franchise for the building of the new system.

DEPOSITION OF ZINC.—A paper on the electrolytic deposition of zinc using electrodes that are rotated was read before the Faraday Society in June by Dr. T. S. Price and Mr. G. H. B. Judge. An improved form of apparatus for the electrolytic deposition of metals using a rotating cathode was described. The ordinary beaker is replaced by a tap funnel of about 100 c.c. capacity, so that the electrolyte can be run off at the end of the experiment, thus obviating the use of a syphon. Use is made of a bicycle hub for rotating the cathode. In the deposition of zinc from a pure solution of the sulphate, no extraneous electrolyte being added, with a current of 2 amp. (cylindrical cathode of gauze, 22 mm. in diameter and 40 mm. long) and voltage 4.5-5.5, the results are uniformly low. The error increases with higher currents, and is due to the heating effect of the current. On keeping the electrolyte cool by means of an ice jacket good results are obtained, even in the presence of free sulphuric acid, provided that the concentration of the latter does not exceed a certain amount (about $n/6$). It was further shown that zinc can be quantitatively deposited from solutions of zinc sulphate, containing 0.2274 grams of zinc in the presence of 2-3 grams of sodium sulphate. The deposit is better than that obtained by the usual method, using sodium acetate and acetic acid; it is not necessary to cool the electrolyte.

JAPANESE ELECTRICAL MACHINERY.—A report on trade conditions in Japan by Mr. R. F. Aist, special agent for the Department of Commerce and Labor, embodies many points of interest as to mechanical and electrical production. It is the practice among Japanese builders of both stationary and marine steam engines to import the various parts from abroad, Europe supplying these necessaries for the most part, and upon receipt of the plates, tubes and other materials to construct the engines in the native works. In the construction of electrical machinery the metal collars and bases for dynamos and motors are cast by one company, while the materials for the construction of commutators and armatures are obtained mostly in America, as are the parts entering into the construction of the large storage battery output. Electrical cranes are among the products of the same company, cranes of 20 and 30 tons capacity having been constructed for various foundries and for the imperial navy yards. Another article quite extensively manufactured by the engineering works of Japan is the "earthquake chimney." It is constructed of rolled steel plates, riveted together. Tall factory chimneys of masonry are prohibited because of the seismic disturbances so severe in Japan. With the growth of manufactures there has been a great demand for steel chimneys, and a consequent large importation of plates for this purpose. The use of electric light wire is also annually increasing, but in its importation English manufacturers have profited most, their sales being fourfold greater than in 1902, while American sales have fallen off more than 8 per cent during that time.

A Bohemian Hydro-Electric Plant.

BY FRANZ KOESTER.

ONE of the most recent of the hydro-electric plants of Europe is that of Messrs. I. Spiro & Sons in Krumman, and it is considered the largest of its kind in Hungary. It supplies electricity for both lamps and motors to the various neighboring industrial concerns and municipal consumers as well as private parties. The water utilized for this purpose is that of the River Moldau, at the side of the so-called "Devil's Wall," near Hohenfurth, from which the plant derives its name. The fact that there are so few plants installed equipped with reaction turbines for the use of high heads makes this plant still more interesting, as it is one of this type. The net head is 310 ft.

For collecting the water a dam 103 ft. in length has been constructed across a certain portion of the Moldau River. This dam, which is of massive concrete, is provided with a fish passage, and at the side is an overflow sluice. The water in entering the intake passes a rack 70 ft. in width directly behind which is located a sand and gravel trap arranged to deflect the foreign matter through two sluice gates, having a combined width of 16.4 ft., lying 6.6 ft. below the crown of the dam. The supply channel 18 ft. in width leads from this point provided with two sluice gates with a total width of 18 ft. As the supply channel for a certain length is also used for drifting lumber, provision is made for the temporary removal of certain members of the above-mentioned rack, which are subsequently replaced. For controlling the flow of water in the supply channel, regulating sluice gates 9.8 ft. wide are provided on the side of the "Devil's Wall." These gates may also be used for draining the supply channel.

The supply channel has a length of 4,412 ft. and enters a collecting basin 45 ft. wide and 33 ft. long. Before entering this collecting basin the water passes through a fine screen and a sand trap, while on the opposite side of the basin are provided two penstock connections, only one of which, however, is at present utilized. These connections are equipped with extra heavy sluice gates resting against rolls in order to facilitate the operation under the extremely high water pressure. In order to give an accurate indication in the power house of the water level in the collecting basin an electric system is employed which shows immediately a change in water level of four inches from normal. There is an overflow at the side of the collecting basin, which also acts as a raceway for the logs, taking them down the mountain slope with the waste water.

The penstock leading down the mountain side is 1,837 ft. long and has an internal diameter of 5.9 ft. On account of the variation in pressure from the bottom to the top of the penstock the thickness varies from 5/8 in. to 46 5/16 in. As the difference in water level in the pipe is 307.3 ft., the bottom of the penstock is designed for a pressure of 131 pounds per square inch. The penstock is made up of riveted steel plates,

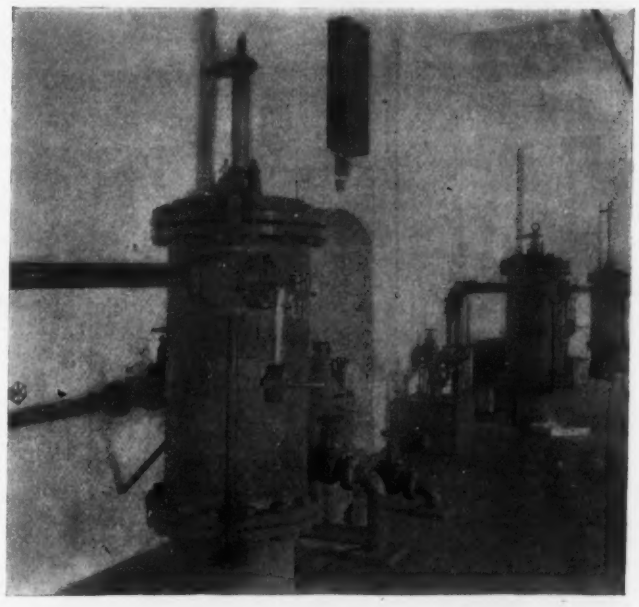


FIG. 2.—SPECIALLY-DESIGNED GATE VALVES.

built in section flanged together, and securely anchored at different points, expansion joints being provided between. At the power house the main penstock enters a separate building from where four branches, 2.9 ft. in diameter, run to the turbines. Here the penstock is well provided with safety valves, sluice gates in the various branches, etc. In order to insure a uniform pressure throughout the penstock, automatic regulating and throttling devices are provided at the lower end. Although at present there is only one penstock leading down to the plant, this penstock building is sufficiently large to accommodate an additional pipe in case of additions to the plant equipment. Specially designed gate valves operated by oil presure have been installed in the penstock building in each of the branch turbine supply pipes. These are clearly shown in Fig. 2. This part of the plant is also occupied by a small Pelton wheel driving a dynamo for lighting the power plant.

The power plant equipment at present consists of only three main units, although there is space for five units, one of which must be supplied from a second main penstock. The power plant building is 160 ft. by 40 ft. wide, while the penstock or

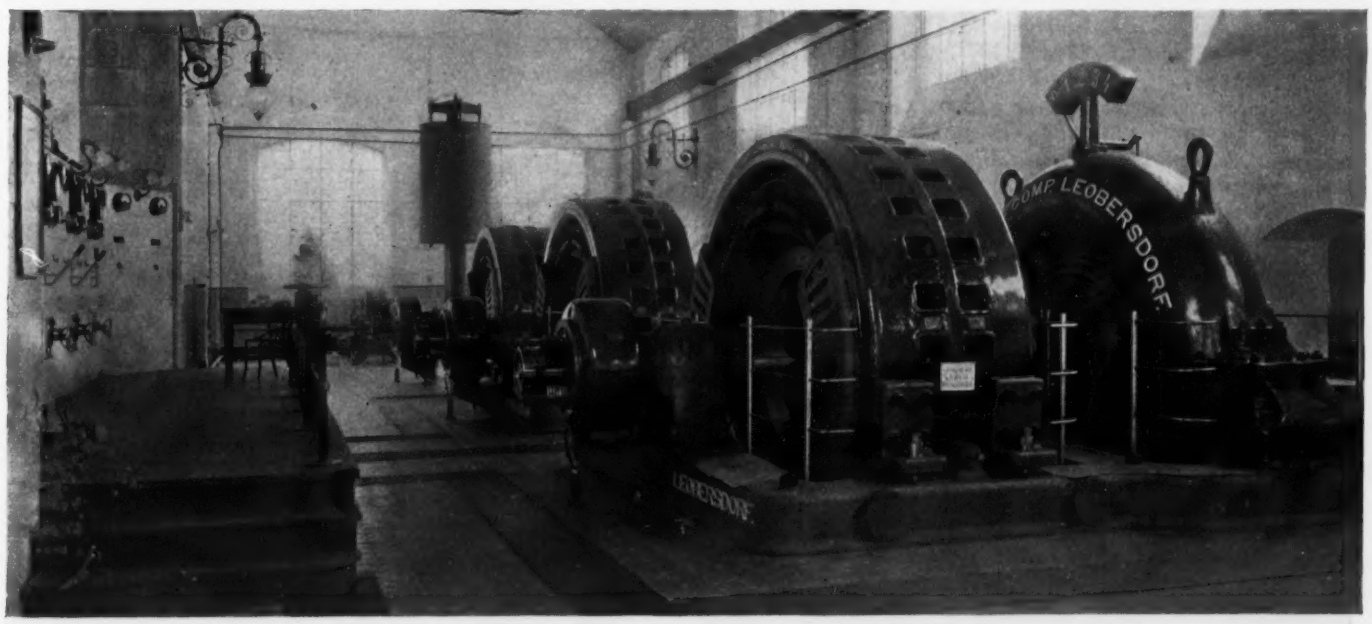


FIG. 1.—INTERIOR OF GENERATING ROOM.

gate house annex is 100 ft. by 28 ft. On the opposite side of the turbine room is located the switching room, 64 ft. by 28 ft., and at the end of the main part of the power house is a section 30 ft. long and the entire width of the turbine room is devoted to repair shops, offices and store rooms.

The turbines with a net head of 310 ft. and at 420 revolutions per minute develop 2,500 brake horse power. The runners are made of cast steel 39.5 inches in diameter and 2.75 inches in width. These turbines were manufactured and installed by

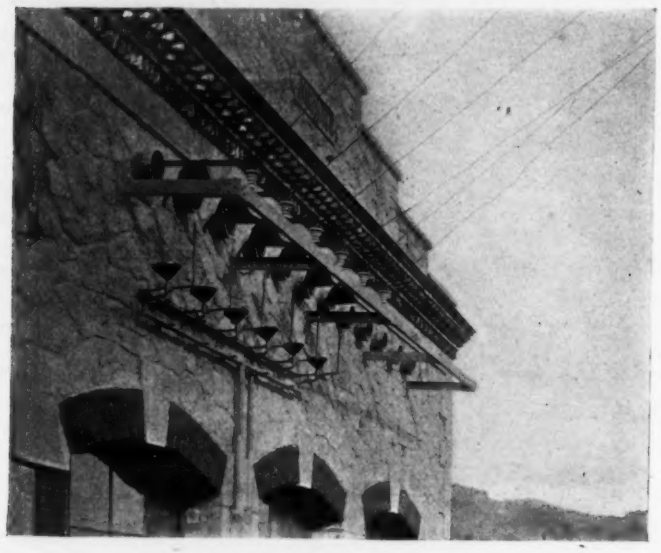


FIG. 3.—WATER-FLOW LIGHTNING ARRESTERS AND OUTGOING FEEDERS.

Ganz & Co., of Budapest, and of the Francis type. The regulation of the turbine is accomplished by means of hydraulic mechanisms and oil cataracts. For this purpose two small Pelton wheels are installed, driving two double-acting pumps, one unit being kept in reserve. These supply a large accumulator.

Directly upon the shaft of each main turbine is mounted a 2,500-kw, three-phase, 15,000-volt, 42-cycle Ganz alternator. On each shaft is also mounted a six-pole, 28-kw, 70-volt, direct-current exciter generator. The main bearings of the turbo generator unit are cooled by water, which water is also used in the hereinafter mentioned lightning arresters.

The generator switchboard is divided into five main panels, one

FIG. 4.—TRANSFORMER STATION.

for each of the generating units, and two auxiliary panels, bearing all the necessary instruments required for the most modern power plant operation. The bus-bars are installed on the ring system with sectionalizing switches installed between adjacent units. Behind the generator switchboard is the distribution switchboard divided into four panels, only two of which are at present utilized. This switchboard is also completely equipped with the requisite fuses, lightning arresters, etc.

The lightning arresters are of particular interest, being of the water spray type now commonly employed in European power plant practice. The circuit is grounded through a stream of water directed against a plate soldered to the outgoing wire. In addition to these lightning arresters, which will be seen in Fig. 3, the plant is equipped with a number of cylinder type arresters. Moreover, each wire on the switchboard is protected by the well known horn lightning arrester. These precautions are necessary on account of the frequent electrical discharges common in these mountainous districts.

From the power plant three distribution lines lead to the different transformer stations where the 15,000 volts are reduced to 300. The equipment of these transformer stations is illustrated in Fig. 4 which represents that at Poetschmuehle. From these sub-stations overhead wires lead to the various large and small consumers.

The entire electrical and mechanical equipment, including part of the lower end of the penstock, was designed and installed by Ganz & Co., of Budapest.

Artificial Production of Nitrate of Lime by Electric Discharge.

By John B. C. Kershaw.

THE production of nitrogen oxides and of nitric acid by spark discharges of electricity through air, has for many years past been attracting the attention of chemists and electricians. Considerable interest has been aroused recently, therefore, by the statement made on what appears to be good authority, that two Norwegian scientists, MM. Birkeland and Eyde, have solved the problem presented by the development of a practical process based on this method, which shall be able to compete with the nitrates obtained from natural sources. At present the natural deposits of nitrates in India and South Africa and the ammonium sulphate recovered as a by-product from coke ovens and from Mond gas producers, supply together nine-tenths of the nitrogen required by man, either as a chemical or as a fertilizer for the soil.

Many years ago a distinguished scientist pointed out that the natural deposits of nitrate of soda in South America, at the present rate of consumption of Chili salt petre, would be exhausted within thirty years, and that there would be a serious diminution in the wheat crops of the world, if some substitute

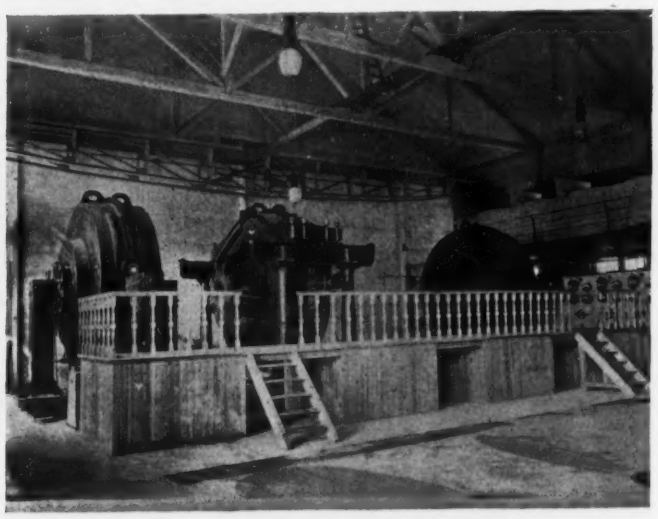


FIG. 1.—GENERATING PLANT, NOTODDEN.

were not provided for supplying the soil with the combined nitrogen necessary for the growth of all cereals. An artificial method of producing nitrates is, therefore, of interest to all scientists, and if the electrical method of burning nitrogen to nitric oxide, as devised by the two Norwegian scientists, yields a product which can compete in price with the present sources of supply, the difficulty as regards the future may be regarded as solved. Cavendish was the first to show that nitric oxide can

be produced by spark discharges through air. This observation was made first in 1781, and since that date Davy, Böttger, McDougall and Howles, Rayleigh, Bradley and Lovejoy, Kowalski and Moscicki, and other chemists have carried out experimental work upon this subject. The following figures taken from a paper by Mesrs. Carveth and Rand, which appeared in the May issue of the *Sibley Journal of Engineering* are of interest, as showing the progress made by different experimenters, in increasing the yield of nitric acid:

Rayleigh	49.1 grams of nitric acid per kw-hr.
MacDougall & Howles	33.8 "
Kowalski & Moscicki	55.0 "
Muthmann & Hofer	70.0 "
Crookes	74.0 "
Bradley & Lovejoy	83.0 "
Birkeland & Eyde	110.0 "

According to Muthmann and Hofer, the maximum yield possible, calculating from the thermal data, is 157.0 grams of nitric

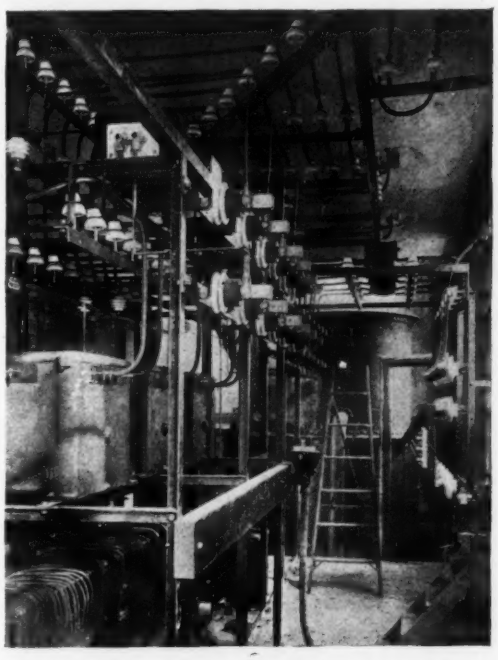


FIG. 2.—ELECTRIC DISCHARGE ROOM.

acid per kw-hour. Only two of the above methods are now being worked upon an industrial scale. The Kowalski and Moscicki process is reported to be receiving trial in Switzerland, while the Birkeland and Eyde process is now working upon a commercial scale at Notodden in Norway. Using Muthmann and Hofer's figures, the electrical efficiency of the first-named process is only 35 per cent, while that of the Birkeland and Eyde process is 70 per cent.

The air is composed, in round numbers, of 79 parts of nitrogen by volume, and 21 parts of oxygen. The aggregate amount of nitrogen which surrounds the earth is, therefore, enormous. If oxygen and nitrogen were gases which readily combine with each other, we should speedily lose our atmosphere, and all living things would be destroyed by the deleterious gases which would be formed. Nitrogen and oxygen are not, however, easily caused to unite, and it requires the high temperature of the electric arc to bring about their union, with formation of nitric oxide gas. This reaction is denoted chemically by the equation:

$$N_2 + O_2 \rightleftharpoons 2NO.$$

This was the fact, observed by Cavendish in 1781, and many chemists since that year have repeated the experiment, and have made attempts to base an industrial process for the production of nitrates, upon this discovery. But the realization of their aims and projects has been hampered by two difficulties. In the first place the yield of nitric oxide per unit of electric energy utilized in the apparatus, by this method, was small, and therefore a cheap supply of electric energy is essential to give these processes any prospects of financial success. This cheap supply of electric energy is not, however, always available. In the second place, the thermal action which produces the union of the nitrogen and oxygen by sparking is a reversible one, as denoted by the arrows in the equation, and the same heat energy which produces the nitric oxide causes its dissociation, unless it is speedily removed from the influence of the electric spark. The first of these two difficulties caused the postponement of all attempts to produce nitrates artificially, until the era of cheap water power development, which marked the closing years of the nineteenth century; and the second, caused the failure of more than one process which has received industrial trial since 1900.

The Bradley and Lovejoy process which was developed at Niagara Falls and was purchased by the Atmospheric Products Company, who attempted to employ it upon an extended scale of operation, did not achieve financial success; and the factory erected at Niagara Falls was obliged to close down, early in 1905. In view of these facts, it may perhaps be still premature to speak of the Birkeland and Eyde process as an assured success, but many independent scientists have investigated it and the plant now being operated at Notodden in Norway, and have been favorably impressed by what they have seen there. The Bradley and Lovejoy process depended upon the use of point discharges of high potential electricity. Messrs. Birkeland and Eyde employ a disc of flame, and it is this disc of flame which they consider the special feature of their process, and is that which gives it a much higher efficiency than any other that has preceded it. The following, according to J. S. Edstrom, are the details of the method by which this disc of flame is produced: The arc is struck between horizontal electrodes, in series with an inductance coil, and the magnetic field is applied by a powerful electromagnet, the poles of which are brought close to the arc, at right angles to the electrodes. The arc is rapidly driven outwards, traveling back along the electrodes until it breaks, when a new arc is instantly formed between the tips of the electrodes, and is driven outwards in its turn, the successive arcs following each other so rapidly that, if desired, thousands may be formed in a second of time. In practice, the frequency is a few hundreds per second. When the arc and the magnet are both fed with direct current, the arc is always deflected to the same side, but when alternating current is used for one, and direct current for the other, the deflections are alternately on opposite sides, and the rapid succession of arcs *gives the appearance of a disc.*

In the first larger units experimented with, from 75 to 200 kw were employed between one pair of electrodes, the arc being struck with alternating current at 500 volts pressure, and 50 cycles per second. The electrodes can be made of copper or iron, can be easily cooled with air or water, and last several hundred hours.

FIG. 3.—INTERIOR VIEW OF NITRATE OF LIME PLANT.

The larger installation of furnaces and plant shown in Figs. 4 to 7 was put into operation at Notodden in May, 1905.

Three generating units and furnaces of 700 hp each have been erected, and when all are working 75,000 litres of air can be passed per minute through the plant. The nitric oxide gas produced by the furnace is oxidized and absorbed in stone towers.

A fifth tower, fed with milk of lime in place of water, is employed for completing the absorption. It is said that only 5 per

cent of the nitrous gases escape absorption by this treatment. Professor Witt, of Berlin, who has personally investigated and reported upon the working of this plant, calculates that half a ton of nitric acid (of 100 per cent) is produced per kw-year, and that at Nôtodden this amount of electric energy costs only four dollars. Each of the furnaces described above, therefore, produces the equivalent of 250 tons (100 per cent) nitric acid per year, equivalent to 325 tons of calcium nitrate, or to 337 tons of nitrate of soda per year. The plant is thus capable of producing nitrates, equivalent to 1,000 tons of Chili saltpetre per year.

A company has been formed in Christiania to exploit the Birkeland and Eyde process on a much larger scale of operations at Notodden, and a capital of 7,000,000 kronin is being raised, partly with the aid of German banks. The factory at Notodden is to be gradually enlarged as more experience is gained with the

FIG. 4.—NITRATE OF LIME READY FOR SHIPMENT.

conduct of the process. It is hoped eventually that 30,000 hp will be utilized in the manufacture of artificial nitrates at this place, and that 20,000 tons of these products will be turned out per annum. The Birkeland and Eyde process is also to be developed in Switzerland and possibly in Germany, if centers whose water power is sufficiently cheap, can be found.

If the above expectations are realized the problem of supplying the world with nitrates for agricultural purposes, to which Sir William Crookes alluded in his presidential address before the British Association at Bristol in 1898, may therefore be regarded as solved. When the nitrate beds of Chili are exhausted, say in 30 years' time, the water powers of America, Switzerland and Norway may have been turned to good account, and nitrogen extracted from the atmosphere by the Birkeland and Eyde or other similar process, may supply the soil with the constituents which have been found necessary for the proper cultivation of the cereal and other crops required for the maintenance of animal life.

Magnet Coils For Arc Lamps.

A patent issued June 19 to Prof. Elihu Thomson describes a process for insulating coils which must withstand excessive moisture and high temperature. Each coil is composed of a single helix of ribbon copper, wound edgewise with the turns close together, so that it forms a tube the thickness of whose wall is the width of the ribbon conductor. After the coil is wound and while there is still some space between the convolutions it is covered by immersion with an insulating and cementing compound consisting of kaolin and silicate of soda. The proportions of these two ingredients is such that the mixture is a viscous liquid, like a water varnish, which will soak into all crevices and form a thin layer between the metal coils. The entire coil is then closed together to form a rigid structure and is then subjected to a low red heat, until the insulating compound is vitrified into an insoluble moisture-proof cement which binds the coils together without permitting contact between its turns. This insulation is a double silicate of aluminum and sodium and is refractory, being incapable of complete fusion except at a temperature which would melt the copper.

Polyphase Magnets.

By D. L. Lindquist.

In an article which appeared in the issue of the Electrical World for June 23, the properties of alternating-current magnets in general were discussed, and the single-phase magnet was treated in detail. The present article outlines the features which should be embodied in the construction of polyphase magnets.

Fig. 1 shows a two-phase magnet which consists of two cores practically alike. Each core is built up of a brass spider, *b*, on which is wound a spiral of iron band (or ribbon); between consecutive layers of iron is a thin sheet of paper fastened with shellac. The interconnection of the four coils of the magnet is shown in Fig. 2.

Assume now that the two-phase e.m.f's impressed upon the

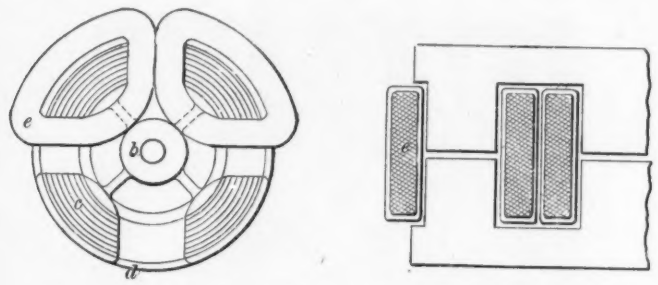


FIG. 1. PLAN AND SECTION VIEWS OF POLYPHASE MAGNET.

coils are in time quadrature with each other, and that the e.m.f. waves are of sine shape. Let the instantaneous density in cores 1 and 2 be represented by B_a and that in cores 3 and 4 by B_b. If the coil resistance and the magnetic leakage are negligible,

$B_a = K \sin \omega t$, where K is a constant,

and $B_b = K \sin (\omega t + \pi/2)$,

$B_b = K \cos \omega t$.

The total pull is proportional to

$$B_a^2 + B_b^2 = K^2 \sin^2 \omega t + K^2 \cos^2 \omega t = K^2.$$

Consequently the pull is proved to be constant at any time and equal to the maximum in any one core. As a result of the construction the resultant pull is always exerted through the center axis of the magnet, thus preventing rocking and the consequent chattering. That a three-phase magnet having three pairs of poles also gives a constant pull can similarly be proved. In practice, however, the two-phase magnet with two pairs of poles has been found suitable for all phases, although it gives slightly less pull when used on three-phase, especially with small air-gaps, as indicated in Figs. 4 and 6, which show tests at 60 cycles on a certain magnet wound with four coils, each containing 220 turns of No. 14 wire, the cross-sectional area of the core being 1.94 sq. in. For large air-gaps the pull is practically the same in the two cases.

The power factor for a certain magnet is practically inde-

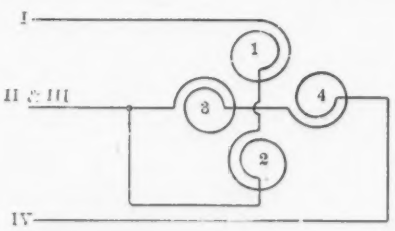
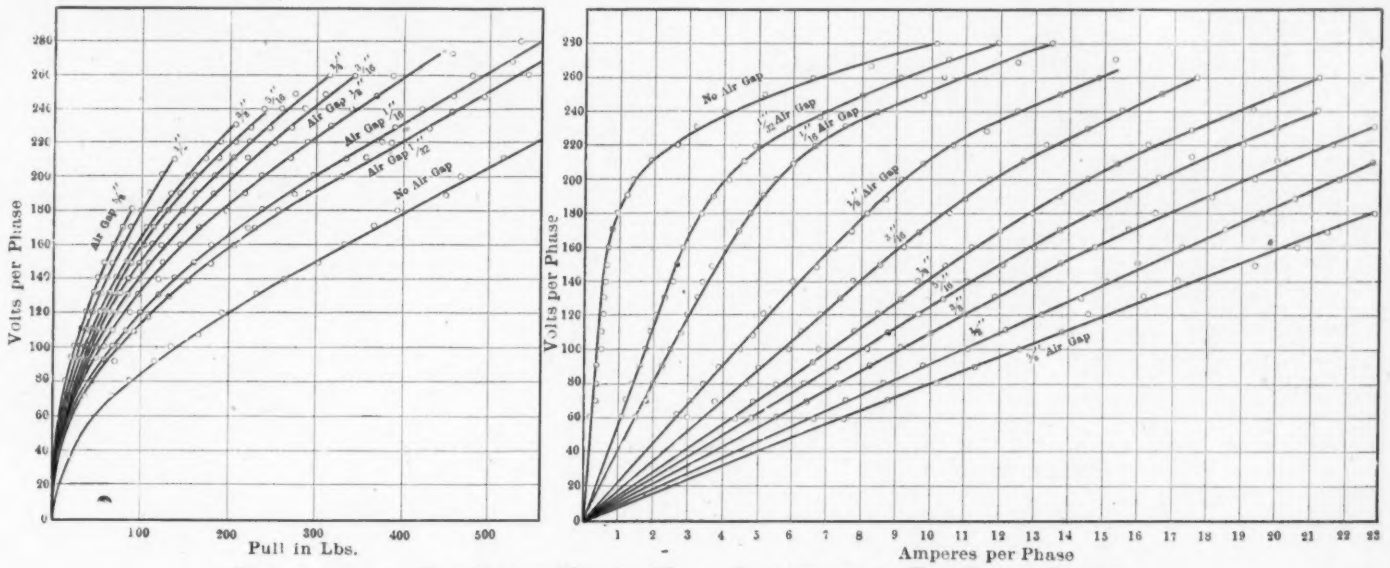


FIG. 2.—CONNECTIONS OF COILS OF POLYPHASE MAGNET.

pendent of the air-gap. It must be mentioned that with increased air-gap and consequently increased leakage, the losses in the core structure increase very considerably. The increased losses are due partly to induced currents in the surrounding brass parts, and to the increased eddy currents in the laminated iron yoke and core caused by stray fluxes. Brass would, therefore, appear to be a poor material to use for clamping the lamination. As a matter of experience, however, where the brass is properly applied, it acts as a shield, preventing the straying of the magnetic flux. In other words, the brass shield forces

the magnet flux to follow the proper direction, thus actually increasing the pull, with a slight increase of current.

Another thing that affects the pull is the position of the air-gap in relation to the coil. In order to get the maximum pull the air-gap must naturally be in the center of the coil. Fig. 7 shows the relation between volts, pull and amperes for a certain two-phase magnet designated as No. 1, with 5/8-in. air-gap between cores. The dotted curves are for the 5/8-in. air-gap, with air-gap center 5/16 in. from coil center, and the full line curves for the 5/8-in. air-gap in the center of the coil. If both cores are movable the air-gap can always be central independent of the length of same. With only one core movable the maximum air-gap for which the coil is to be used ought to be in the center of the coil.



FIGS. 3 AND 4.—TWO-PHASE MAGNET NO. 1 SUPPLIED WITH TWO-PHASE CURRENT.

Noise is a factor that must be seriously considered in polyphase magnets. There are first of all internal vibrations due to looseness of component parts. It is necessary, therefore, to have the iron lamination clamped as tightly as possible. The laminated construction shown in Fig. 1 makes the core practically as firm as a solid piece of iron. When the magnet is energized and holding it is very important that the movable poles and the stationary poles have very intimate contact throughout their entire attracting surfaces.

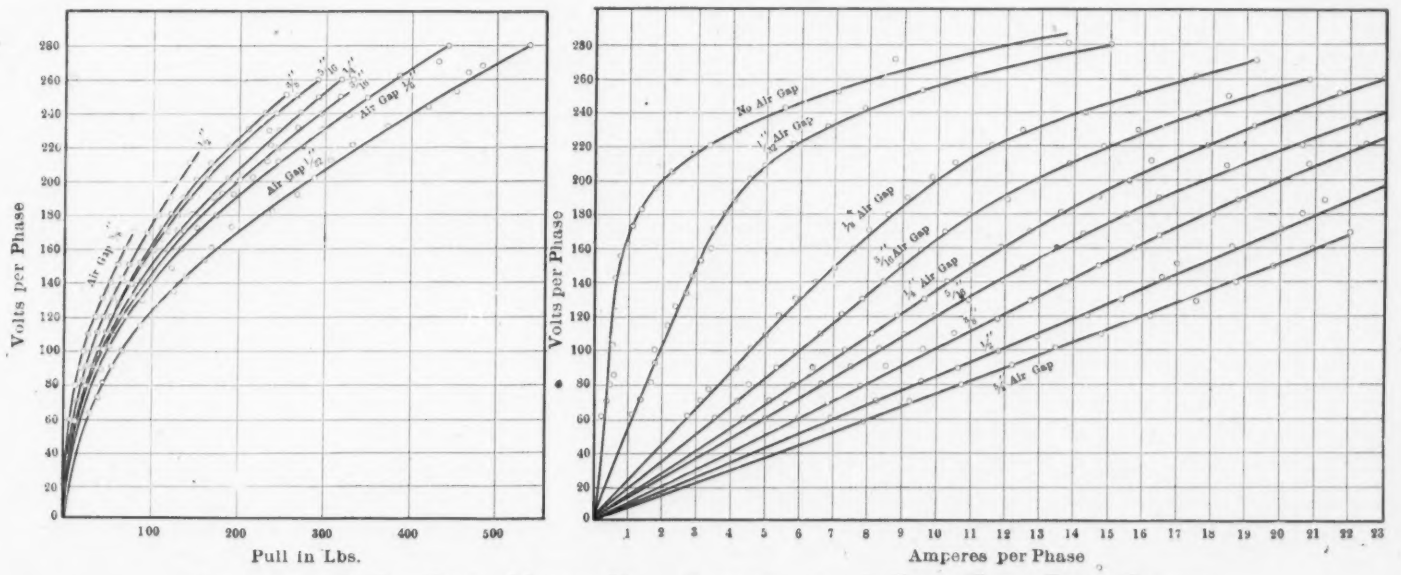
As previously proved where the coil resistance is negligible, and the magnet has a pair of poles for each phase, a polyphase magnet when energized by a sine-shaped e.m.f. exerts a constant pull. As a matter of fact, however, in almost every case the e.m.f. is more or less distorted, due to many causes, the coil resistance having a certain influence, and there must be some variation in the pull. If a two-phase magnet is used on a three-phase circuit there will be an additional variation in pull due to this fact. A polyphase magnet should, therefore, never be loaded to such an extent that the load exceeds the minimum instantaneous pull of the magnet.

Suppose that the load is in excess of this minimum, then the conditions would be the same as with a single-phase magnet; the armature would leave the fixed pole when the pull was less than the load, causing a blow when returning.. The total pull is proportional to

$$e_1^2 + e_2^2 = \sin^2 a + \sin^2 (a + 2\pi/3),$$

hence, if the average pull is 1., the maximum pull is 1.5, and the minimum .5.

Fig. 8 shows the results of tests on the two-phase magnet designated as No. 1 when energized with three-phase current, the load being increased until the magnet made a noise. As seen from these curves compared with Figs. 3 and 5, giving the pull when energized with two-phase and three-phase current, the magnet will commence to be noisy at about one-half the load, but in general it will hold without noise all the load it can lift, so long as the length of motion is not too short.



FIGS. 5 AND 6.—TWO-PHASE MAGNET NO. 1 SUPPLIED WITH 60-CYCLE, THREE-PHASE CURRENT.

As seen from Fig. 9, magnet No. 1 has its maximum relation between pull and volt-ampere, or its best apparent efficiency, for an air-gap of about 1/4 in., and therefore a magnet of this size will be used to its best advantage when lifting through a distance of about 1/4 in. As the size of the magnet increases, naturally the length of "best" stroke increases. If a magnet

is used with "best" stroke the magnet will always be able to hold without noise the load lifted, even in the case of a two-phase magnet energized with three-phase current.

All of these curves shown herewith have been plotted from actual tests with the temperature of the magnet the same as that

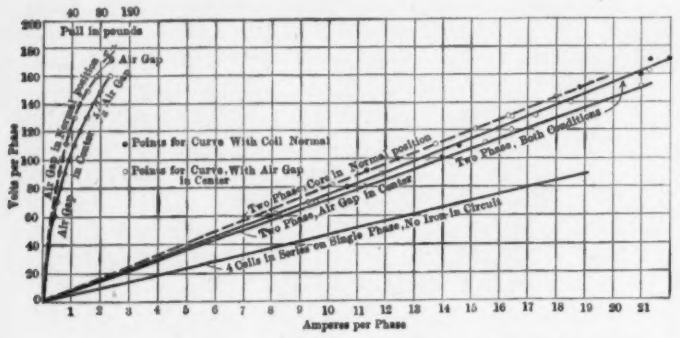

Pull in pounds
Volts per Phase
Amperes per Phase
Points for Curve With Coil Normal
Points for Curve With Air Gap in Center
Two Phase, Core in Normal Position
Two Phase, Air Gap in Center
Two Phase, Both Conditions
4 Coils in Series on Single Phase, No Iron in Circuit

FIG. 7.—AIR-GAPS IN CENTER AND 5/16-IN. ABOVE CENTER.

of the room (25° C.) or slightly above. As the temperature increases the eddy currents decrease, and both the current and the total losses decrease considerably, especially for zero air-gap. A certain test was made to find out how the losses and current consumption varied at different temperatures. A No. 1 magnet was energized with high voltage to heat the coils and the core. The temperature rise of the core was 57° C. and of coils 69° C.

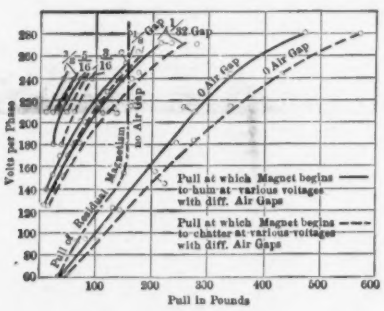

Volts per Phase
Pull in Pounds
Pull at which Magnet begins to hum at various voltages with diff. Air Gaps
Pull at which Magnet begins to chatter at various voltages with diff. Air Gaps
0 Air Gap

FIG. 8.—PULL OF TWO-PHASE MAGNET SUPPLIED WITH THREE-PHASE CURRENT.

It was then found that with the same voltage and zero air-gap the current consumption was only 85 per cent of the current consumption when the magnet was at the room temperature. The ohmic resistance of the coils increased 28 per cent, and the C^2R losses in the coils were about 92 per cent of the losses when

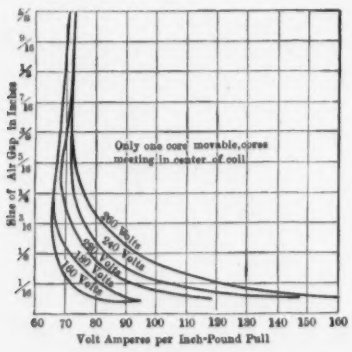

Size of Air Gap in Inches
Volt Amperes per Inch-Pound Pull
Only one core movable, cores meeting in center of coil
360 Volts
240 Volts
200 Volts
160 Volts

FIG. 9.—VOLT-AMPERES OF TWO-PHASE MAGNET SUPPLIED WITH THREE-PHASE CURRENT.

the coils were cold. The total losses were 85 per cent of the losses when the magnet was cold. As the C^2R losses in the coils were only about 35 per cent of total losses, the iron losses when hot were only 81.5 per cent of the iron losses when cold, due to decrease in eddy currents. This decreasing of the losses when the temperature increases is naturally very advantageous, especially for magnets having to hold their loads continuously.

Series - Parallel Armature Windings with Equipotential Connections.—II.

By Prof. E. Arnold.

Conditions for $\frac{Z}{a}$ and $\frac{K}{a}$ equal to a whole number in series-parallel windings.

We will now examine in what cases the condition that $\frac{Z}{a} =$ whole number can be satisfied.

If in the formula

$$y_k = \frac{K \pm a}{p},$$

the value $\frac{u_n}{2} Z$ be put for K and the value $g =$ a whole number for $\frac{Z}{a}$, i. e., $Z = a\,g$, we get

$$y_k = \frac{K \pm a}{p} = \frac{\frac{u_n}{2} Z + a}{p} = \frac{a}{p}\left(\frac{u_n}{2} g \pm 1\right)$$

If the fraction $\frac{a}{p}$ be reduced so that $\frac{a}{p} = \frac{t}{r}$, in which t and r have no common factor, we can put

$$y_k = \frac{t}{r}\left(\frac{u_n}{2} g \pm 1\right) \qquad (7)$$

From this equation can be determined for what proportions of a, p and u_n the pitch y_k can be made a whole number.

If only the values 2, 4, 6 and 8 be considered for u_n we get, if $\frac{Z}{a}$ is to be a whole number, the following conditions for the winding:

(1) If r is divisible by 2 and not by 3, u_n must be $= 2$ or 6.
(2) If r is divisible by 3 and not by 2, u_n must be $= 2$, 4 or 8.
(3) If r is divisible by 2 and 3 u_n must be $= 2$.
(4) If r is not divisible by either 2 or 3, u_n must be $= 2$, 4, 6 or 8.

From these conditions is compiled the following table which shows *the proportions for which* $\frac{Z}{a}$ *can be made a whole number.*

$p=1$	$u_n=2,\ 4,\ 6,\ 8$	for all values of a
$p=2$	$u_n=2,\ —,\ 6,\ —$	$a=1,\ 3$
	$u_n=2,\ 4,\ 6,\ 8$	$a=2,\ 4$
$p=3$	$u_n=2,\ 4,\ —,\ 8$	$a=1,\ 2,\ 4,\ 5$
	$u_n=2,\ 4,\ 6,\ 8$	$a=3,\ 6$
$p=4$	$u_n=2,\ —,\ 6,\ —$	$a=1,\ 2,\ 3,\ 5,\ 6,\ 7$
	$u_n=2,\ 4,\ 6,\ 8$	$a=4,\ 8$
$p=5$	$u_n=2,\ 4,\ 6,\ 8$	for all values of a
$p=6$	$u_n=2,\ —,\ —,\ —$	$a=1,\ 5,\ 7,\ 11$
	$u_n=2,\ 4,\ —,\ 8$	$a=2,\ 4,\ 8,\ 10$
	$u_n=2,\ —,\ 6,\ —$	$a=3,\ 9$
	$u_n=2,\ 4,\ 6,\ 8$	$a=6,\ 12$
$p=7$	$u_n=2,\ 4,\ 6,\ 8$	for all values of a
$p=8$	$u_n=2,\ —,\ 6,\ —$	$a=1,\ 2,\ 3,\ 4,\ 5,\ 6,\ 7,\ 9,\ 10,\ 11,\ 12,\ 13,\ 14,\ 15$
	$u_n=2,\ 4,\ 6,\ 8$	$a=8,\ 16$
$p=9$	$u_n=2,\ 4,\ —,\ 8$	$a=1,\ 2,\ 3,\ 4,\ 5,\ 6,\ 7,\ 8,\ 10,\ 11,\ 12,\ 13,\ 14,\ 15,\ 16,\ 17$
	$u_n=2,\ 4,\ 6,\ 8$	$a=9,\ 18$
$p=10$	$u_n=2,\ —,\ 6,\ —$	$a=1,\ 3,\ 5,\ 7,\ 9,\ 11,\ 13,\ 15,\ 17,\ 19$
	$u_n=2,\ 4,\ 6,\ 8$	$a=2,\ 4,\ 6,\ 8,\ 10,\ 12,\ 14,\ 16,\ 18,\ 20$
$p=11$	$u_n=2,\ 4,\ 6,\ 8$	for all values of a
$p=12$	$u_n=2,\ —,\ —,\ —$	$a=1,\ 2,\ 5,\ 7,\ 10,\ 11,\ 13,\ 14,\ 17,\ 19,\ 22,\ 23$
	$u_n=2,\ —,\ 6,\ —$	$a=3,\ 6,\ 9,\ 15,\ 18,\ 21$
	$u_n=2,\ 4,\ —,\ 8$	$a=4,\ 8,\ 16,\ 20$
	$u_n=2,\ 4,\ 6,\ 8$	$a=12,\ 24$
$p=13$	$u_n=2,\ 4,\ 6,\ 8$	for all values of a
$p=14$	$u_n=2,\ —,\ 6,\ —$	$a=1,\ 3,\ 5,\ 7,\ 9,\ 11,\ 13,\ 15,\ 17,\ 19,\ 21,\ 23,\ 25,\ 27$
	$u_n=2,\ 4,\ 6,\ 8$	$a=2,\ 4,\ 6,\ 8,\ 10,\ 12,\ 14,\ 16,\ 18,\ 20,\ 22,\ 24,\ 26,\ 28$
$p=15$	$u_n=2,\ 4,\ —,\ 8$	$a=1,\ 2,\ 4,\ 5,\ 7,\ 8,\ 10,\ 11,\ 13,\ 14,\ 16,\ 17,\ 19,\ 20,\ 22,\ 23,\ 25,\ 26,\ 28,\ 29$
	$u_n=2,\ 4,\ 6,\ 8$	$a=3,\ 6,\ 9,\ 12,\ 15,\ 18,\ 21,\ 24,\ 27,\ 30$

$p=16$	$u_n=2, -\ 6, -$	$a=1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31$
	$u_n=2, 4, 6, 8$	$a=16\ 32$
$p=17$	$u_n=2, 4, 6, 8$	for all values of a
$p=18$	$u_n=2, - - -$	$a=1, 3, 5, 7, 11, 13, 15, 17, 19, 21, 23, 25, 29, 31, 33, 35$
	$u_n=2, 4, - 8$	$a=2, 4, 6, 8, 10, 12, 14, 16, 20, 22, 24, 26, 28, 30, 32, 34$
	$u_n=2, - 6, -$	$a=9, 27$
	$u_n=2, 4, 6, 8$	$a=18, 36$
$p=19$	$u_n=2, 4, 6, 8$	for all values of a
$p=20$	$u_n=2, - 6, -$	$a=1, 2, 3, 5, 6, 7, 9, 10, 11, 13, 14, 15, 17, 18, 19, 21, 23, 22, 25, 26, 27, 29, 30, 31, 33, 34, 35, 37, 38, 39$
	$u_n=2, 4, 6, 8$	$a=4, 8, 12, 16, 20, 28, 32, 36, 40$

From the equation

$$y_k = \frac{K \pm a}{p} = \frac{a}{p}\left(\frac{K}{a} \pm 1\right)$$

it is seen that the condition $\frac{K}{a}$ = a whole number can always be fulfilled for a regularly distributed winding; for slotted armatures in which every slot is to have the same number of conductors there exists the further requirement that K divided by $\frac{u_n}{2}$ must be equal to a whole number.

A closer examination shows us that the condition $\frac{K}{a}$ equal to a whole number, when the number of conductors in each slot is the same, can be fulfilled if

(1) a is divisible by $\frac{u_n}{2}$ or

(2) the proportions in the table, for $\frac{Z}{a}$ equal to a whole number, hold.

HOW K AND a AND ALSO Z AND a MAY BE MADE DIVISIBLE BY ADDING DEAD BARS AND INCREASING THE NUMBER OF SLOTS.

It was seen above that it is not always possible to fulfill the condition that $\frac{K}{a}$ may be a whole number and to have at the same time $\frac{K}{\frac{u_n}{2}}$, also equal to a whole number. In these cases the *chief condition of symmetry, i. e., that* $\frac{K}{a}$ *be equal to a whole number is to be fulfilled.*

By increasing the number of slots and adding dead bars the condition that $\frac{Z}{a}$ be a whole number can always be fulfilled. If we add $2a$ dead bars then $\frac{Z}{a}$ is always equal to a whole number.

The examination of different windings has shown that the errors which exist in windings for which $\frac{p}{a}$ is not a whole number are not diminished by increasing the number of slots to a value which is divisible by a.

On the other hand, windings with $\frac{p}{a}$ = to a whole number and for which the condition that $\frac{Z}{a}$ = a whole number cannot be fulfilled without increasing the number of slots, are by this means made completely symmetrical.

Only with series-parallel windings in which $\frac{p}{a}$ = a whole number will the condition that $\frac{Z}{a}$ be a whole number (and $\frac{K}{a}$ = a whole number) be fulfilled by increasing the number of slots.

With series-parallel windings in which $\frac{p}{a}$ is not a whole number it is possible only to make $\frac{K}{a}$ = a whole number.

SUMMARY OF THE CONDITIONS OF SYMMETRY FOR SLOTTED ARMATURES WITH SERIES-PARALLEL WINDINGS.

The chief condition that $\frac{K}{a}$ = whole number must always be fulfilled. In windings with $\frac{p}{a}$ = to a whole number, the condition that $\frac{Z}{a}$ = whole number must always be fulfilled. If $\frac{a}{p}$ is equal to a whole number it is sufficient that $\frac{Z}{p}$ be a whole number.

Only those windings in which $\frac{a}{p}$ or $\frac{p}{a}$ is equal to a whole number and for which these conditions are fulfilled will be completely symmetrical.

For the other windings less importance is to be attached to the fulfilling of the condition $\frac{Z}{a}$ = a whole number. But when possible the proportions should always be so chosen that without auxiliary means $\frac{Z}{a}$ becomes a whole number (see table).

As soon as an error appears in the potential pitch it is necessary to determine whether the error exceeds a certain allowable limit.

CALCULATION OF PITCH ERROR.

By placing the coil sides in slots, their position is different from what it would be with regularly distributed winding. For the latter winding, in which the conductors are all at the same distance from one another, the error is easily expressed by a formula.

With a slotted armature the position of the bars relatively to one another is so different that in order to determine the error it is simplest to draw out the position of the conductor in the

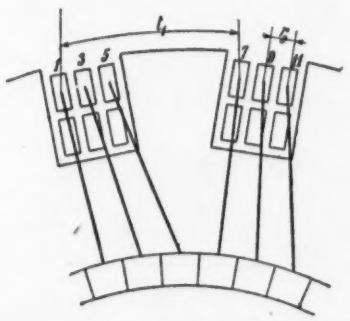


FIG. 3.—ARRANGEMENT OF CONDUCTORS AND COMMUTATOR SEGMENTS.

slot and the position of the corresponding conductor in a regularly distributed winding. The error is then calculated for the distributed winding and the amount found by which the position of the conductor differs when the winding is in slots and when it is regularly distributed; from these two errors the resulting error can be found.

We will next determine by how much the position of a coil side differs when the winding is in slots and when regularly distributed.

In Fig. 3 two slots are drawn and the connections of the upper conductors to the commutator segments is shown diagrammatically. The distance between two neighboring conductors in a slot is denoted by r_s, or if measured in commutator segments by $r\beta$. We can now write:

$t_1 : r_s = \frac{u_n}{2}$ commutator segments : $r\beta$ commutator segments,

or $r\beta = \frac{r_s\, u_n}{2t_1}$ commutator segments.

If we consider the winding as regularly distributed along the circumference of the armature then the distance between two neighboring conductors is equal to 1 commutator segment.

If we further suppose that the coil sides 1 and 7 retain the same position on the armature, which they would have with a regularly distributed winding and the other coil sides displaced out of the position they would have with a regularly distributed winding, then the coil sides 3 and 9 will be displaced by an amount $\left(1 - \frac{r_s\, u_n}{2t_1}\right)$ and the coil sides 5 and 11 by an amount $2\left(1 - \frac{r_s\, u_n}{2t_1}\right)$

In series-parallel windings with $\frac{p}{a}$ and $\frac{Z}{a}$ equal to a whole number, or with $\frac{a}{p}$ and $\frac{Z}{p}$ equal to a whole number, no error occurs, therefore, $a_x = 0$.

With all other series-parallel windings errors always occur. The calculation of these errors can best be shown by means of an example. Take, therefore,

$$a < p; \quad \frac{Z}{a} = \text{a whole number.}$$

The calculation of a machine has given as the most favorable proportions, $p = 6$, $a = 4$, $u_n = 4$, when K is about 404. From the above table it is seen that for the proportions $p = 6$, $a = 4$, and $u_n = 4$, the condition $\frac{Z}{a} =$ a whole number can be satisfied.

We choose then $K = 400$ and $Z = 200$. The commutator pitch is then

$$y_k = \frac{400 - 4}{6} = 66.$$

Since y_k and K have 2 as the greatest common factor the winding is doubly closed. For the calculation of the equipotential pitch we use the formula

$$y_p = x\, y_k \pm 1,$$

and for the calculation of the pitch error the formula

$$a_x = \pm\left(1 - x\,\frac{a}{p}\right)$$

Since the number of connections of a system is equal to $a(=4)$, then $x_1 + x_2 + x_3 + x_4 = p = 6$,
and we get:

$x_1 = 1$	$y_{p1} = 1 \times 66 + 1 = 67$	$a_{x1} = 1 - 1\frac{4}{6} = \frac{1}{3}$
$x_2 = 2$	$y_{p2} = 2 \times 66 + 1 = 133$	$a_{x2} = 1 - 2\frac{4}{6} = -\frac{1}{3}$
$x_3 = 1$	$y_{p3} = 1 \times 66 + 1 = 67$	$a_{x3} = 1 - 1\frac{4}{6} = \frac{1}{3}$
$x_4 = 2$	$y_{p4} = 2 \times 66 + 1 = 133$	$a_{x4} = 1 - 2\frac{4}{6} = -\frac{1}{3}$

Commutator segment 1 is to be connected with segment $1 + 67 = 68$; $68 + 133 = 201$; $201 + 67 = 268$. The segments 1, 68, 201 and 268 are connected respectively to the coil sides 1, 135, 401, 535. In Fig. 4*a* the coil sides are shown in their positions in the slot.

In Fig. 4*b* the positions of the coil sides are shown, when the conductors are regularly distributed on the armature circumference. Now, $\frac{K}{p} = \frac{400}{6} = 66\frac{2}{3}$ and $\frac{2K}{p} = 133\frac{1}{3}$. The pitches y_{p1} and y_{p3} are thus too great by $\frac{1}{3}$ of a commutator segment, while the pitches y_{p2} and y_{p4} are too small by $\frac{1}{3}$ of a commutator segment.

In Fig. 4*c* the coil sides are shown in a position for which their potentials are equal and for which, therefore, no error arises.

As shown above, the distance between two conductors in the slot is equal to $\frac{r_s\, u_n}{2t_1}$ commutator segments, and we can therefore, determine the displacement of each coil side from the position of equality of potential.

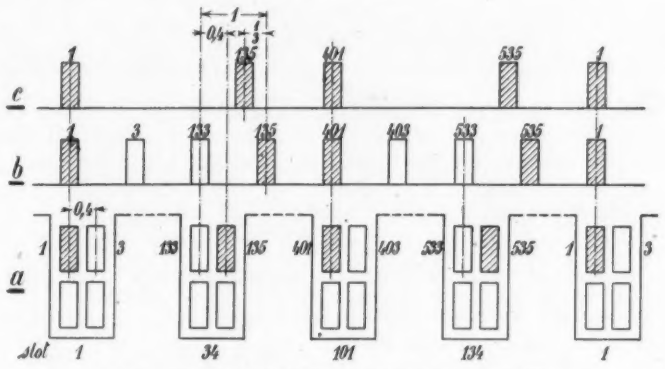


FIG. 4.—ARRANGEMENT OF COILS AND SLOTS.

If we assume $\frac{r_s\, u_n}{2t_1} = 0.4$, the errors for the coil sides 135 and 535 are equal.

$$a_n = 1 - \frac{1}{3} - 0.4 = 0.27 \text{ commutator segment.}$$

or $$a_x^\circ = a\,\frac{360}{K}\,a_n = 4 \cdot \frac{360}{400} \cdot 0.27 = .97^\circ.$$

As will be seen later, the amount of this error is quite allowable. If we connect the segments 2, 69, 202 and 269 to a system, then the coil sides connected to these segments are respectively 3, 137, 403, 537. For this case are shown in Fig. 5*a* the positions of the coil sides in the slot; in Fig. 5*b* the positions of the coil sides when the winding is regularly distributed, and in Fig. 5*c* the positions of the coil sides for equality of potential. The error for coil sides 137 and 537 is here

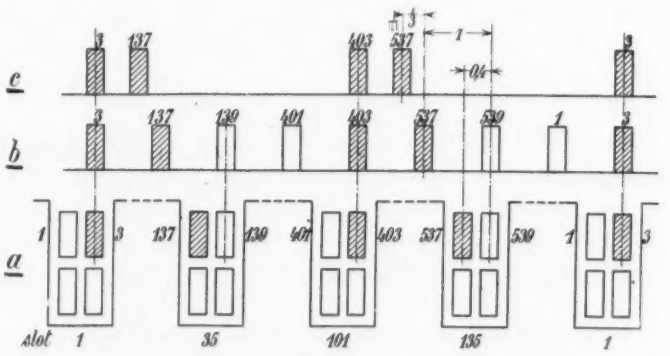


FIG. 5.—ARRANGEMENT OF COILS AND SLOTS.

$$a_n = 1 + \frac{1}{3} - 0.4 = 0.93$$

or $$a_n^\circ = a\,\frac{360}{400}\,a_n = 4 \cdot \frac{360}{400} \cdot 0.93 = 3.35^\circ.$$

This error reaches the allowable limit. Thus the smallest error of only 0.97° is made if we start from the left-hand top coil side of the slot and begin with the smaller pitch.

It is to be noticed further that a and p have the greatest common factor, 2, and since Z is divisible by 2, two points of a system will have exactly the same potential. In Figs. 4 and 5, the coil sides 1 and 401, 3 and 403, respectively, have the same potential.

We will choose the following: As a second example there may be taken winding data $p = 4$, $a = 2$, $u_n = 4$. It is seen from the table that for this winding the condition $\frac{Z}{a}$ = a whole number cannot be fulfilled without auxiliary means. We will,

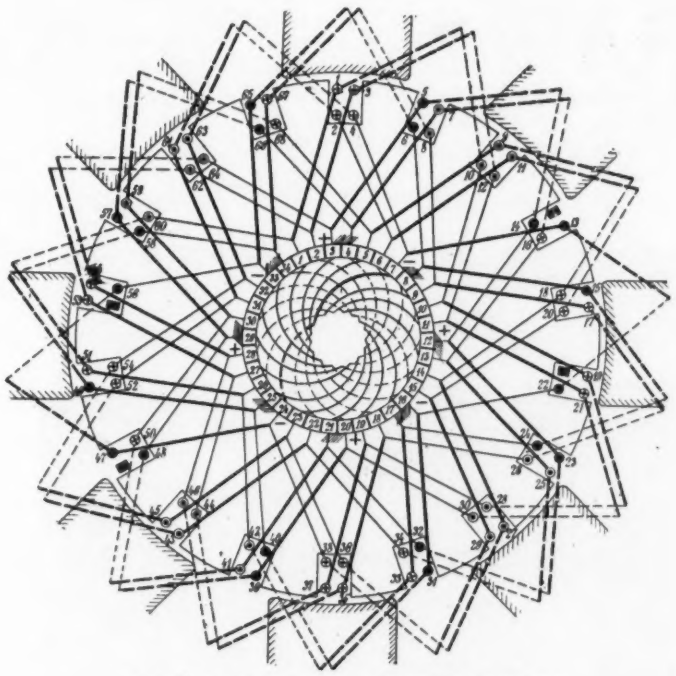


FIG. 6.—SYMMETRICAL ARMATURE WINDING.

however, satisfy the condition for this winding by adding $2a = 4$ dead bars. We choose $s = 68$ and $K = 34$. The total number of coil sides, inclusive of dead coil sides, will then be $= 2.34 + 4 = 72$, and the number of slots $= \frac{72}{4} = 18$. Then $\frac{Z}{a} = \frac{18}{2}$ = a whole number. The position of the dead conductors is so chosen that they are symmetrically distributed around the armature circumference.

All similarly situated coil sides of both groups lie in the same field, as is shown in Fig. 6. Through increasing the number of slots the winding has been made completely symmetrical.

COMPARISON OF THE VALUES OF $a_n{}^\circ$ IN MACHINES BUILT.

In the following table the error $a_n{}^\circ$ is shown for different machines constructed with series-parallel windings.

Remarks are added as to the behavior of the machine. The machines 14 and 15, with pitch errors of 4.4° and 5.1°, respectively, showed the presence of large internal currents on running, which did not, however, cause undue heating, and the commutation was good.

The last machine had to be rebuilt as it became too hot on account of the internal currents. The error is 7.1° for this machine.

In the columns $\frac{p}{a}$ and $\frac{Z}{a}$ the symbols wh.n. and n.wh.n. are used, which indicate whether $\frac{p}{a}$ and $\frac{Z}{a}$, respectively, are whole numbers (wh.n.) or not a whole numbers (n.wh.n.).

TABLE OF PITCH-ERROR a_n AND $a_n{}^0$ IN MACHINES BUILT WITH SERIES-PARALLEL-WINDINGS.

No.	p	u	K	Z	u_n	$\frac{p}{a}$	$\frac{Z}{a}$	$\frac{r_z u_n}{2.f_1}$	$a_n\,max$	$a_n{}^0 max$	Remarks.
1	6	3	609	203	6	wh.n.	n.wh.n.	0.4	1.2	2.13	
2	6	2	490	245	4	wh.n.	n.wh.n.	0.35	0.65	0.95	
3	6	3	651	217	6	wh.n.	n.wh.n.	0.4	1.2	2.0	
4	5	2	303	303	2	n.wh.n.	n.wh.n.	—	0.2	0.48	
5	5	3	412	412	2	n.wh.n.	n.wh.n.	—	0.4	1.05	
6	3	2	236	118	4	n.wh.n.	wh.n.	0.5	0.83	2.55	
7	3	3	285	95	6	wh.n.	n.wh.n.	0.3	1.4	5.3	Sensitive.
8	4	2	366	183	4	wh.n.	n.wh.n.	0.3	0.7	1.38	
9	6	3	795	265	6	wh.n.	n.wh.n.	0.3	1.4	1.9	
10	4	2	238	119	4	wh.n.	n.wh.n.	0.55	0.45	1.35	
11	4	2	422	141	6	wh.n.	n.wh.n.	0.5	1.0	1.7	In 2 slots, 1 dead bar.
12	4	2	342	171	4	wh.n.	n.wh.n.	0.4	0.6	1.26	
13	6	2	776	259	6	wh.n.	n.wh.n.	0.5	1.0	0.95	In 2 slots 1 dead bar.
14	2	2	164	55	6	wh.n.	n.wh.n.	0.5	1.0	4.4	In 2 slots 1 dead bar.
15	2	2	140	47	6	wh.n.	n.wh.n.	0.5	1.0	5.1	In 2 slots 1 dead bar.
16	3	3	213	71	6	wh.n.	n.wh.n.	0.3	1.4	7.1	Had to be rebuilt.

THE NUMBER OF EQUIPOTENTIAL CONNECTIONS.

It is not necessary that all segments should be joined to equipotential connections, although in view of the equalizing of the short-circuit current the greatest possible number of connections is desirable. In most cases it is sufficient to connect only ⅓, ¼, ⅕, 1/10 or still less of the segments. In series-parallel windings p coils are passed over each time a complete round of the armature is made, whose sides, in the case of drum windings, are so distributed under all the poles that one coil side lies under each pole and we step a segments further on the commutator circumference.

Thus, even when the strengths of the poles are different, the same e.m.f's are produced in every p coils. If we arrange, therefore, by means of the equipotential connections every p coils or a whole multiple of p coils in opposition in that we connect in the first case, only the a^{th} segment to equipotential connections, *no internal armature currents can arise from the inequality of the pole strengths and at the same time the beneficial effect of the equipotential circuits on the commutation remains.*

In Fig. 7a part of the wave winding is shown for

$$p = 3,\ a = 3,\ yk = 11,\ K = 3.11 - 3 = 30,$$
$$y_{p1} = y_{p2} = y_{p3} = 1.11 - 1 = 10.$$

Starting from segment 1 we arrive after one round at segment $1 + a = 4$, and after a second round to segment $4 + a = 7$.

In the loop 1—12—23—4—24—13—2—21—1 formed by the equipotential, p coils are arranged against p coils and their e.m.f's balance one another even with poles of unequal strength.

In this lies an important superiority of the series-parallel windings as compared with the lap windings, and this holds also when $a = p$; that is, when it is possible to use a lap winding.

If all the segments (1—11, 2—12) had been joined to equipotential connections and not only every a^{th} segment (1—11, 4—14), the coils, for example, 1—12 (9 volts) and 21—2 (11

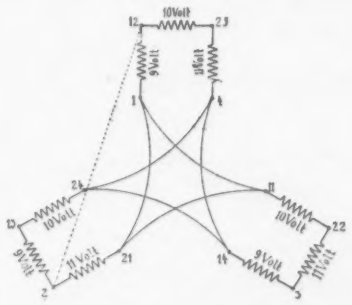


FIG. 7.—PART OF WAVE WINDING.

volts), would have been arranged in series and given rise to internal currents. With lap windings a compensation of this kind is impossible. In view, however, of the unbalancing of the armature it is desirable, in turbo-generators, for example, to compensate for the magnetic pull due to the unequal pole strengths. In this case the number of connections should be such that the difference of the field strengths will be neutralized by the internal currents.

An Improved Spark Recorder.

By Prof. F. W. Springer.

The apparatus shown in the accompanying illustrations was designed and constructed by Messrs. Hoff, Lang, Mowry and Payne, senior electrical engineers at the University of Minnesota, for use on electric cars and locomotives.

Its operation in general is the same as that of the apparatus described in these columns by the writer July 1, 1905. There are, however, a number of marked improvements, not only in the design and arrangement of the apparatus, but in the method of running the records of line voltage, car speed and current on the same strip of paper with the same zero line.

Referring to Fig. 2, the secondary terminal of a vibrating jump spark coil, J_1, is connected successively to the pointers of voltmeters, V_1 and V_2 and ammeter, A_2, by means of a secondary distributor, D, so that sparks pass across a small gap at the ends of the pointers, P_1, P_2, P_3, to the spark terminals arranged in the hard rubber blocks, B_1, B_2, B_3. Each block contains 150 thin strip terminals which are connected to a telephone terminal board, T, by means of 150 small rubber covered wires, A B. A straight rubber block, H_4, contains 150 spark points which are so connected to T by means of the wires, A B, that O H_4 corresponds to a uniform scale deflection on each instrument.

A small shunt motor, connected in series with a number of incandescent lamps to the trolley line, operates the secondary distributor so that a record is made of the positions of the pointers, P_1, P_2, P_3, successively by the sparks passing from O H_4 to the metal cylinder, C, at intervals of a few thousandths of a second.

A second spark coil, J_2, is arranged to operate at fifteen seconds intervals by completing the primary circuit, as shown in Fig. 2, the notched wheel, K, being mounted on the seconds spindle of a clock. The time intervals thus recorded not only serve to check up the chronograph speed but also mark the zero line of the curves.

The curves thus recorded may be traced while holding the paper strip between the observer and a strong light, or they may be transferred by means of stencil ink and a roller. Any number of legible copies may be made by the latter method.

By placing an adjustable resistance in series with the primary coil of the jump spark coil, the size of the spark may be regulated so that the paper will be just burned sufficiently to make the curves visible without printing or tracing.

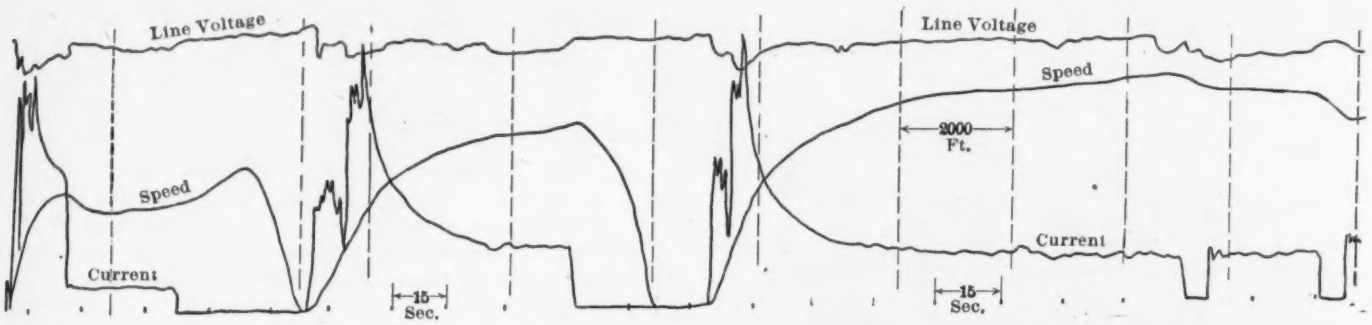


Fig. 1.—Record of Test on High-Speed Interurban Car Equipped with Four 75-hp Motors.

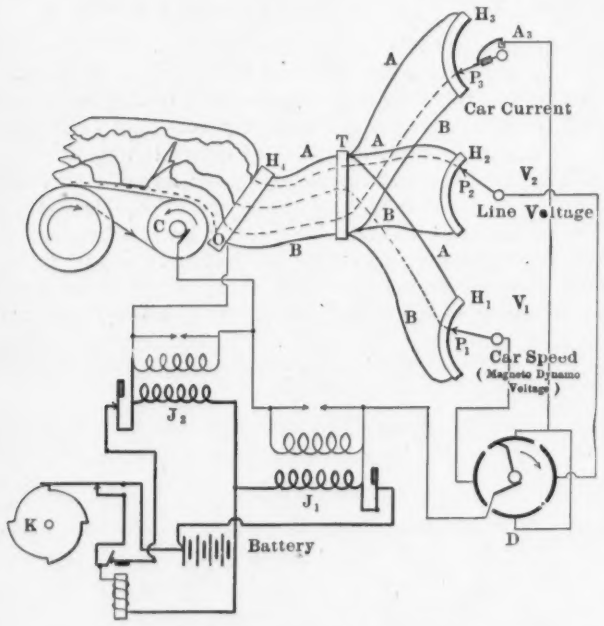


FIG. 2.—DIAGRAM OF WIRING OF SPARK RECORDER.

The curves of line voltage, car speed and car current, shown in Fig. 1, were traced from a record taken on a high-speed interurban car of the Twin City Rapid Transit Co., of Minneapolis.

FIG. 3.—GENERAL VIEW OF SPARK RECORDER.

Electrically Operated Cold-Storage Plant.

The Lehigh Valley Coal Company has recently installed at Ransom, Pa., a 400,000-ton anthracite coal storage plant which is stated to be one of the most economically-operated plants in existence. A series of receiving bins is built under a track trestle paralleling the storage ground. A trimmer, which resembles a traveling crane with its transverse truss at an angle of about 30° with the horizontal, serves for elevating the coal and carrying it to any position in the stock yard. The trimmer is equipped with a conveyor which receives the coal from chutes below the bins and delivers it at the point desired; this conveyor is driven by a 90-hp Thompson-Ryan motor. A 50-hp Westinghouse motor serves for moving the trimmer truss over the storage area. All of the operations connected with the handling of the coal are performed mechanically by electric motor-driven equipments. The coal storage apparatus was designed and installed by the Dodge Coal Storage Company, Nicetown, Pa. It is stated that by means of this apparatus the cost of handling the coal both ways will be less than 5 cents per ton.

Electric Generating Equipment for a Gold Mine.

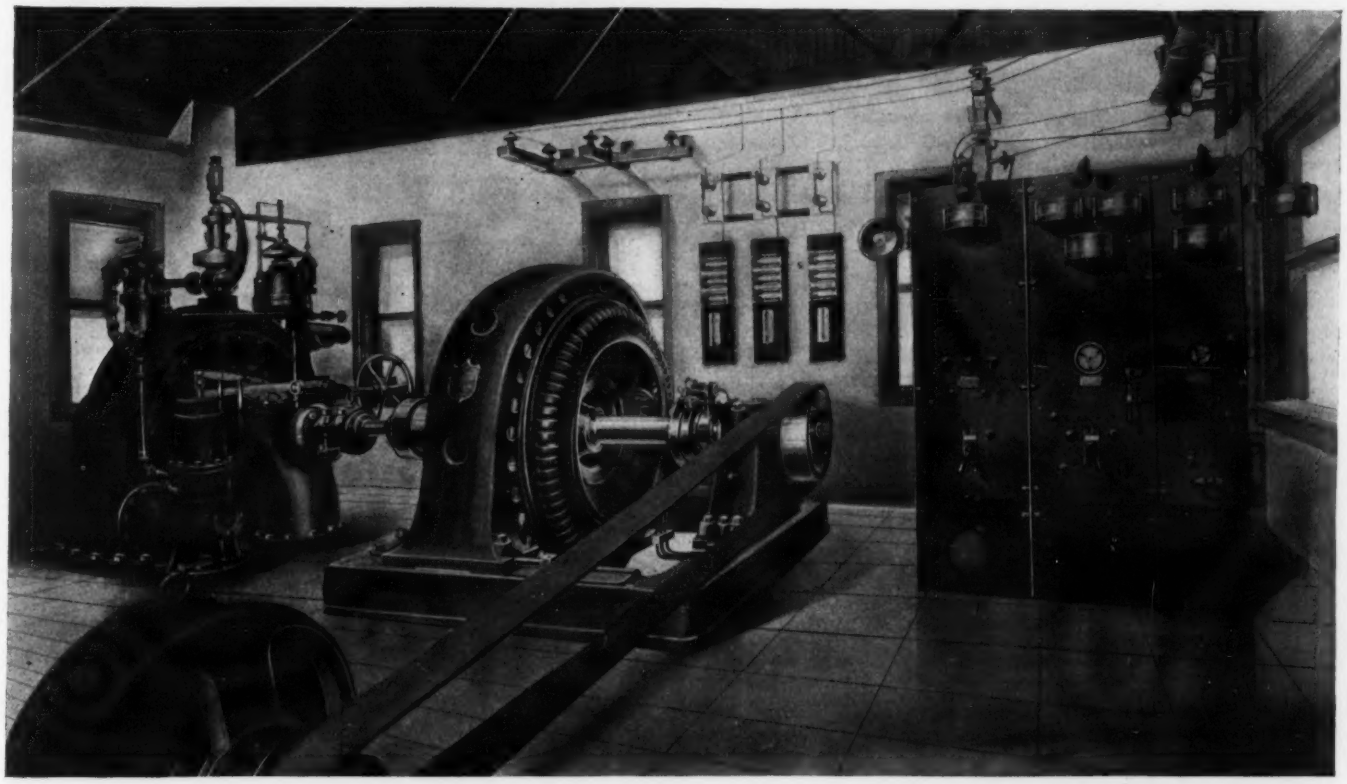
A generating equipment which may be considered as a typical modern hydro-electric power installation for a gold mine is found in the plant recently completed by the Palmer Mountain Tunnel & Power Company. The plant is located on the Toats Coulee Creek, in the Palmer Mountains, near the town of Loomis, Washington, about 12 miles south of the international boundary line between the United States and British Columbia.

A little over one mile from the power station is located the intake of the flume, which consists of a heavy concrete pier abutting solid granite bedrock and anchored thereto, running out into the bed of the creek about 14 ft. The intake and gate are constructed with adjusting gear and lock devices for governing the flow of water. The flume, which runs along the mountain side until it is 365 ft. above the power plant, is 5,424 ft. in length. It is constructed of heavy material throughout. The mud sills are all 6-in. by 6-in. material, 6 ft. long laid crosswise of the grade, 4 ft. apart from center to center. On these are placed for the entire length of the flume three stringers of 3-in. by 4-in. material 2 ft. apart. On the stringers are laid 4-in. by 4-in. ties 4 ft. apart. On these ties are laid the bottom of the flume, which consists of four 2-in. planks 12 in. in width, making the bottom 4 ft. wide. For the support of the sides, uprights of 3-in. by 4-in. material are dapt into the 4-in. by 4-in. ties, which were allowed to project outside of the bottom. To the uprights are spiked the sides of flume, which are 1½-in. planks, 2 ft. high. On the top of the uprights across the flume is spiked a 3-in. by 4-in. cap, which binds the flume together. On the tangent every other tie has been allowed to project 2 ft. beyond the bottom of the flume. From this projection to the upright a brace is fitted in at an angle of 45°. On the curves this bracing is on every tie thus making it impossible to rack the flume at any point. On the top of the caps a cover has been laid, this also answering for the purpose of the floor, over which all the materials for the construction were run as the flume progressed. About one-half of the sills are on bedrock, the balance being on earth. Those on the earth are the only part of the work subject to decay, and can be renewed at any time without disturbing the flume. Very little trestling has been necessary, and what has been constructed has been done in a very substantial manner. Culverts have been put in at all points where the least possible chance of damage from snow and water might occur. Overflow and safety gates are at convenient points, and three large sand boxes have been constructed to trap any grit that the water may carry during high water, thus insuring the turbine wheel against wear by sand cutting. The construction is first-class throughout, and there is no leakage whatever, which is very remarkable for a flume of this length.

The penstock, which runs down the mountain side, connecting the flume with the turbine wheel is 676.8 ft. in length. Beginning at the top it is 34 in. in diameter and is gradually reduced to 27 in. From 27 in. it is gradually reduced to 24 in. in diameter. The upper part is constructed of 3/16-in. steel and the lower part ¼-in. steel. The seams are all double-riveted, while the turns are single-riveted, ⅝-in. rivets being used throughout. It is made up in 32-ft. sections with steel flange joints bolted together.

The power house is 36 ft. by 26 ft. and constructed of concrete. The walls are 12 in. and the foundations 24 in. in thickness. The floor is of cement and the machinery foundations and tailrace, which extend 12 ft. below the floor are all of concrete.

The turbine is of the Escher-Wyss type, designed especially for this installation. All of the turbine is above the floor of the power house and the working parts are directly under the eye of the operator. The turbine has a working head of 365 ft. and runs at 600 r.p.m.



INTERIOR VIEW OF TOATS COULEE CREEK POWER STATION.

Directly connected to the turbine is a 450-kw, 6,600-volt, three-phase, 60-cycle generator. The machine is of the revolving-field type. As shown in the accompanying illustration, the exciter is belted to the shaft of the generator. This machine also supplies electricity for lighting the power house and the operator's cottage.

The transmission line running from the power house to the mine is 11,554 ft. in length. The poles, which are of tamarack, are 40 ft. in length, and are set 5 ft. in the ground. That portion of the pole that goes under ground has been treated with a creosote asphaltum preparation. The wire used is seven-strand aluminum cable mounted on Locke porcelain insulators. A secondary distributing circuit for which the e.m.f. is reduced by transformers to 110 volts is run from the mine to the town of Loomis. All of the business houses and many of the residences of this town are now using the electricity for lamps. A modern 300-ton mill, equipped with automatic appliances throughout for quick and economical handling of the ores will be installed in the near future.

Both the hydraulic and the electric equipment of the plant were supplied by the Allis-Chalmers Company. We are indebted to Mr. John Boyd, general manager of the Palmer Mountain Tunnel & Power Company, for the above information.

A Novel Public Service Building in Milwaukee.

In connection with the recent meeting of the American Institute of Electrical Engineers at Milwaukee, note was made of the fact that the exercises took place in the new "public service" building of the Milwaukee Electric Railway & Light Company. This structure, which we are now able to illustrate, and to describe more fully, through the courtesy of Mr. John T. Beggs, president and general manager of the company, is a most interesting example, and probably the furthest reach of a tendency on the part of such corporations to study the public welfare while securing for itself larger facilities for necessary work. A typical example is the fine Edison Auditorium in this city, equipped as meeting room and library, by the New York Edison Company, above a sub-station equipment, and used by several national and local engineering bodies for their meetings. Mr. Beggs has now concentrated under one roof admirable accommodations for all of the offices of the company, a terminal station with all the requirements for passengers, dining-rooms, machine shops, physical and chemical laboratories, a convention hall and a 4,500-kw generating plant, which will be installed in the basement. He has with entire appropriateness named this comprehensive center of utilities the Public Service Building.

The structure occupies the entire block bounded by Sycamore, Second and Third Streets and Everett Street, and measures 200 ft. by 300 ft. It is of steel framework construction. The columns are encased in concrete and rest on concrete footings, which are carried by piles. While the building is at present four stories high, provision has been made for an additional height of eight stories whenever the conditions require it. The basement and the first floor of the building cover the entire block, but the three upper stories are broken by three light courts 20 ft. wide which extend from the rear and are carried about three-fourths the depth of the building and divide the rear of the building into four wings. The exterior finish is Bedford stone and gray Norman brick. The two-story rotunda in the interior is in light shades of Siena marble, enriched with a frieze of panels of Swiss Cipilino. White Italian marble is freely used, and the interior woodwork is throughout of birch, except the handsome presidential suite in fumed oak and the directors' room in solid mahogany.

FIG. 1.—PUBLIC SERVICE BUILDING.

The natural lighting is aided by a light court and the artificial lighting is by electricity alone, for which a series of tests was conducted by O. M. Rau, superintendent of the electric lighting department, and his assistant, F. A. Vaughn, electrical engineer of this department, in order to arrive at the best method to be followed. The method finally decided upon is that of providing an even distribution of light rather than concentrating lamps in central chandeliers. With very few exceptions all portions of the building are lighted by individual incandescent lamps suspended about 3 ft. from the ceiling by brass electroliers. These electroliers are fitted with the new General Electric metallized filament lamps of 50, 75 and 100 cp, the intense glow of the filament being softened by frosting the lower portion of the bulb. Each of the electroliers is fitted with either a C or a D Holophane reflector, the former over desks where a concentration of light is desired, and the latter where general diffu-

FIG. 2.—TESTING RACK.

sion is wanted. The lighting of all the offices was figured out on a basis of 2 candle feet at the desks, and practically the same basis was used in the lighting of the corridors, toilet rooms and other portions of the building. In several portions, for example, the theatre and the directors' room, an ornamental effect rather than equal distribution was aimed at.

The telephone service also received the attention of the electric lighting department which has charge of the telephones of the trolley dispatching system. The Strowger automatic system is combined with the Bell system. A telephone room on the second floor contains an automatic exchange as well as a manual switchboard for the building and a dispatcher's board. In an adjacent room is installed a storage battery with a motor-generator set which is used in connection with the telephone system, while quite an elaborate marble switchboard for all the low-voltage electrical apparatus in the building is installed in the partition between the rooms. There are at present about 100 telephones installed throughout the building. The wires are carried in conduits to distributing points on each floor, thence they extend under the floor and are brought up at points where desks are at present located or where they may possibly be located in the future. In some of the rooms these outlets are placed at intervals of about 10 or 12 ft., so that no matter where a desk may be placed telephone connections can be obtained without difficulty. Desk telephones of the automatic system are employed, fitted with Bell transmitters. Each telephone is provided with a key which permits the use of the manual or of the automatic exchange at will. The manual board is interconnected with the dispatcher's board, so that any of the offices may be given connection with the booths of the dispatcher's system out on the interurban lines. Connections are also made with the city telephone system and with long-distance telephones.

In some of the departments a rather unusual arrangement is carried out by having what might be termed branch exchanges. While calls may be sent out from any telephone in the department, all calls are received at a central desk where the nature of the business is determined and connection then given to the proper party.

In the several offices and corridors of the building there are placed about 40 electric clocks, which are operated in synchronism with a master clock located in the telephone exchange

room. One of the clocks is placed over the main entrance to the building, another is mounted over the main stairway from the first floor, while a third, which is of unique design, is located in the room of the private secretary to the president and general manager. This latter clock is placed in a panel with carved figures representing industry and time on either side.

At the rear of the test room is the installation and repair department, and opening from the large central room devoted to general work are several small ones used for different purposes. One of these contains electrically-driven arc light globe washers and electro-magnetic carbon cutters. Another is equipped with several grinders and buffers used in finishing switchboard and other brass and copper work. This room is provided with an exhaust fan having tubes running to each machine. Near the rear of the building is a locker and toilet room for the employes in the shop. A freight elevator in the southeast corner of the building handles all heavy work going into and out of the shop, as well as electric meters.

In a single room near the southwest corner of the building on the fourth floor is located the printing department, which prints the street railway transfers and rules, as well as all the forms used by the company. The printing office is supplied with a Miehle 33-in. by 48-in. cylinder press, a two-color Harris automatic press for printing transfers and small forms, a double-decked ruling machine, job presses, stitching machine, perforating machine and other machines for similar work.

FIG. 3.—TELEPHONE EXCHANGE.

While the storeroom of the lighting department is located in the southern end, the greater portion of the basement is taken up by a power plant, elevator machinery, air compressors and refrigerating machines. A contract for furnishing steam to the Milwaukee Central Heating Company was primarily responsible for the installation of the power plant, which when completed will consist of ten 500-kw Edgemoor boilers and three 1,500-kw Allis-Chalmers Parsons turbines. The limited amount of space available introduced several difficulties in the installation of the boilers, which are arranged in one row near the south wall of the building. Although of 500 hp each boiler is installed in a space 12 ft. 9 in. high and 16 ft. 5 in. wide. The boilers are fed by two Worthington 14-in. by 8½-in. by 15-in. center-packed piston plunger pumps installed in connection with two 1,500-hp Hoppes heaters. As power could be obtained at a comparatively low cost by passing the steam through engines before turning it into the heating mains leaving the building, the three 1,500-kw turbines already mentioned will be installed in the central portion of the building. These turbines are specially constructed to operate non-condensing, and will operate with a back pressure of 7 lb. With this pressure, which is equivalent to 22 lb. absolute back pressure, and with 150 lb. pressure at the throttle, these turbines have a guaranteed consumption of 44 lb. of dry steam per kw-hour at three-fourths load, 40 lb. at full load and 41 lb. at one-fourth overload. The Bullock generators driven by the turbines are 2,300-volt, 60-cycle, three-phase, with an exciter mounted on the same shaft. Part of the alternating current generated will be sent out of the station without transformation or conversion, but the greater portion of it will be supplied through two 1,500-kw motor-generator sets to the direct-current Edison system feeding the business district of the city. A storage battery installed in the basement is floated on the Edison system. The battery consists of 320 G-39 chloride cells, and is provided with end-cell switches and connections. Space has been left near the center of the building for another battery of twice this size when the growth of the system demands. In connection with the battery there is installed a 150-kw booster set. The switchboard for all the electrical apparatus in the basement and also for lighting the building is located under the sidewalk.

The boilers in the basement and the turbines will only be operated during the winter season when steam is required in the heating mains. As a summer load provision has been made for the installation of two 100-ton steam-driven ammonia refrigerating plants, it being the idea to furnish refrigeration to hotels, cafes and other places of business in the vicinity. At present one 28-ton Vilter Manufacturing Company's motor-driven ice machine is installed, which is used to cool the spring water in the tanks in the basement and to furnish refrigeration to the kitchen and the lunch counter in the waiting room. Two 150-ft. motor-driven Christensen air compressors are installed near the ice machine. These compressors maintain a constant air pressure in four tanks near by, which are used to operate the pneumatic tube system in the building, the pneumatic tools and the heat regulating system, and to open elevator doors. All the elevators are electrically driven, the machinery being located in the basement. Two passenger elevators are said to be the first drum-type, electrically-driven elevators which have a speed of 600 ft. per minute; they are built for 1,500 lb. load. Two freight elevators, one in each of the rear corners of the buildings, are built for 4,000 lb. and travel at 250 ft. per minute. In addition to the elevators mentioned there are also two sidewalk hoists and a hoist from the storeroom of the electric lighting department to the salesroom above.

Steel Cable and Tower Transmission Line in Syracuse.

Mention has been made in our columns from time to time of the 60,000-volt transmission line from Niagara Falls to Syracuse, and detailed information was given in our issue for April 14, 1906, concerning the steel towers used in the neighborhood of Niagara Falls and from Niagara Falls to Rochester, and the wooden frames employed from Rochester to Syracuse. We are able to give below a description of the transmission line in Syracuse, where both the poles and the cables are built of steel.

From the western city line of Syracuse, for a distance of two miles, the transmission line is carried on especially designed steel towers over three railroads and several factories and buildings, and terminates at a substation of the Syracuse Rapid Transit Company on the bank of the Erie Canal at Tracy Street. Along this portion of the route there are forty towers, ranging in height from 45 ft. to 63 ft., measured from the ground to the top of the bottom insulator. The total length of the towers in each case is from 10 ft. to 11 ft. longer than this when the sections entering the ground and extending above the bottom cross-arm are included.

An unusual feature of the equipment resides in the use of steel cable for the conductors. Each leg of the three-phase circuit consists of a seven-strand, 7/16-in., plow-steel cable. Each cable is strung in one length from the terminal at the sub-station to the terminal at the city line. Steel was used in these cables in place of copper or aluminum, primarily for greater strength. The average span is approximately 240 ft., the longest single span being 407 ft.

The insulators are of the 60,000-volt, triple-petticoat, porce-

lain type, supplied by R. Thomas & Sons Company, of East Liverpool, Ohio. The insulators are carried on the cross-arms by means of special malleable-iron pins. The form of the pin is shown in Fig. 1. It will be noticed that the pin has a flat base designed to set squarely upon the cross-arm, to which it is bolted by means of four 5/8-in. bolts. This method of attaching the pins to the towers was adopted for greater convenience in installing. The parts of the insulators are cemented together and the insulators are connected by the pins. Each cable is tied to the insulators with annealed tie wire so arranged as to break at a maximum pull of 1,000 lbs. in order to avoid breaking the insulators or cross-arms should unusual strains be put upon the cables. At the double cross-arm and dead end-towers the

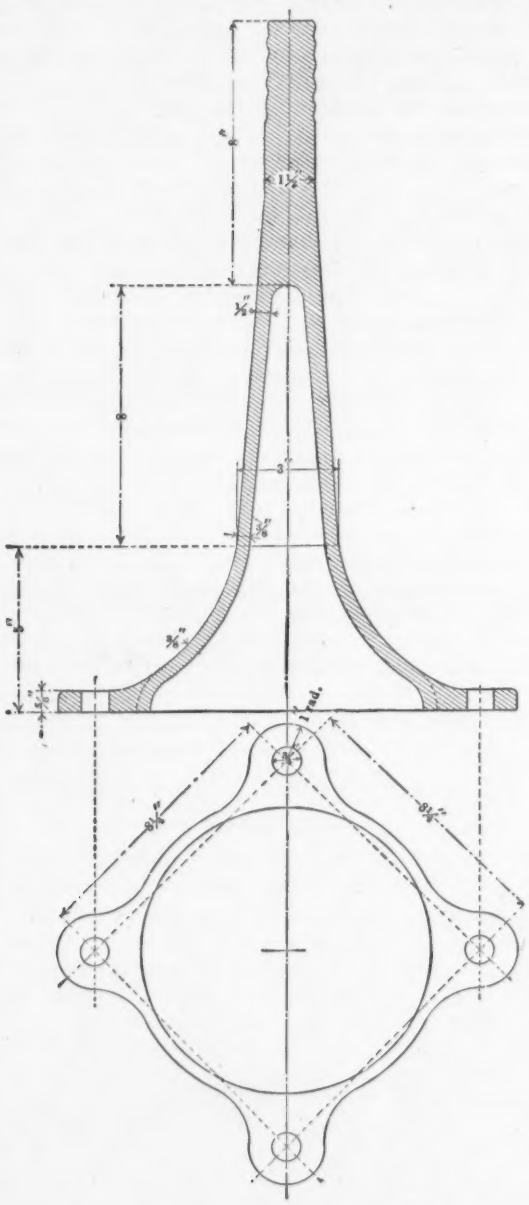


FIG. 1.—DETAILS OF INSULATOR PIN.

cables are clamped to equalizing saddles cemented to the top of the insulators. The saddles are arranged to facilitate removing a broken or defective insulator.

In designing the line the assumed wind load was taken as 1¼ lbs. per lineal foot of cable, based on ¼ in. of sleet and a wind pressure of 30 lbs. per ft. on a flat surface, or 15 lbs. on a round surface. The dead-end towers were designed to provide also for endwise strains under maximum wind and sleet loads; calculating these strains, a sag not exceeding one-twentieth of the span was allowed. The minimum sag allowed was 1 ft. in 40 ft. The heights of towers was arranged to provide ample clearance over buildings and wires. The towers at the angles were designed to provide for side strains due to the tension in the cables based on the sags stated, and also for the pressure of the wind on the cable and on the tower. Enough insulators were provided at the angle towers so that the cable does not make any angle of over 8½ degs. on any one insulator. Where possible the cable was slacked off on spans adjacent to angles of over 2 degrees. The towers at angles and dead-ends are stiff structures designed to provide for the

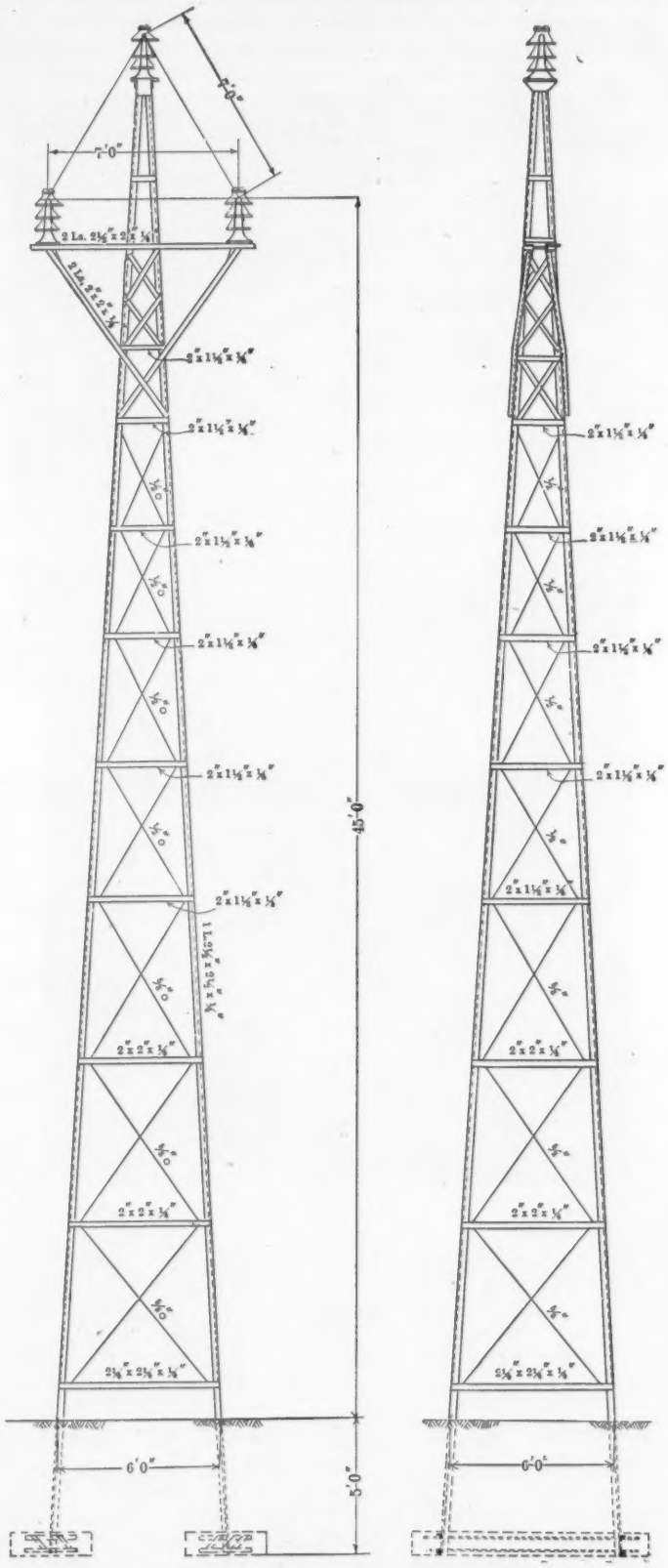


FIG. 2.—DETAILS OF 45-FT. ANGLE TOWER.

greatest assumed strains. The wind pressure on the tower itself was assumed at 60 lbs. per panel on each half of tower.

The design of the towers in general is as indicated in the drawing of a 45-ft. tower shown in Fig. 2. In towers of greater height the section of the upright members in the lower panels was increased. The cross-arms of all towers were designed to resist torsional strains due to the pull of the cable on the tops of the insulators. The maximum pull allowable on a single cross-

arm tower was 1,000 lbs. for each cable, the ties, as stated, being designed to break at this tension. The cross-arms of towers at dead-ends carry three insulators for each cable, and are designed to resist the maximum calculated pull due to the assumed conditions of load and sag. Bolted joints in the main members of towers were designed on the basis of 10,000 lbs. shearing per sq. in. and 20,000 lbs. bearing per sq. in.

The following are the chief features of the towers: Towers 57 ft. high and over are supported on concrete piers. Each leg of the tower is anchored by two 1-in. bolts running to the footings. The footing under each pier is 5 ft. x 3 ft. x 10 in. thick, reinforced at the top to resist uplift. For the lighter towers under 57 ft. high, the concrete piers were omitted and the legs of the tower were spliced to angle-irons which extend down into the ground. Each of these angle footings was enclosed in a piece of stove pipe which was filled with cement grouting to prevent corrosion.

The towers were riveted in complete form so far as practicable at the shop, the actual field connections being bolted at the point of location before erection. The towers were raised and set, completely assembled, by the use of a tower wagon. The erecting wagon had a boom 40 ft. long, which was first raised by means of block and fall and a team of horses. The boom was then guyed three ways and used as a gin pole for erecting the tower. On similar work the contractor with this apparatus, one team, and a gang of eight men has raised as many as twenty towers in one day.

The towers were given one shop coat of red lead and oil and one coat in the field of graphite paint. They were erected by the Archbold-Brady Company, of Syracuse, which acted as engineer and contractor, and furnished the design for the towers and the insulator pins.

Recent Electrochemical Developments.

ELECTRIC FURNACES.

In the manufacture of special alloy steels, such as are used for high-speed tools, armor plates, etc., the element which is intended to give special properties to the steel is introduced into the metal either in form of the pure metal or of a ferro alloy. The pure metals used for such work, like chromium, tungsten, etc., are generally produced by the aluminothermic reaction; their advantage is that they are free from carbon, so that by introducing the metal into the steel bath no carbon is included. The ferro-alloys are mostly made in the electric furnace, especially the high-percentage ferro-alloys, which are now much in favor with steel men; the lower the percentage of iron in the ferro the less is its content of carbon and the smaller, therefore, the danger of introducing a prohibitive amount of carbon into the metallic bath. The advantage of the use of ferro-alloys over that of pure metals is that the ferro has a lower melting point so that the alloying process does not require a specially high temperature.

The manufacture of ferro-alloys, which is in principle very simple, is essentially the same as was used many years ago in the experiments of Cowles brothers for making alloys in the electric furnace. For making, for instance, ferro silicon, a mixture of iron (or iron oxide), silica and carbon represents the charge and the chemical reaction in the furnace is simply the reduction of the oxides by means of the carbon resulting in the production of an alloy of iron and silicon. This reduction requires a high temperature and on account of this high temperature the electric furnace has proven specially successful.

Mr. A. J. Rossi, the well known pioneer with ferro-titanium, has recently patented a process for making titanium-steel, the special feature of which is that he does not first produce ferro-titanium. He feeds into an electric furnace an ascertained quantity of pig iron containing a definite quantity of carbon and then adds a predetermined quantity of granulated oxides of titanium calculated to be sufficient to decarburize the pig iron to the required extent. He raises the temperature to, 3,200 or 3,500° F., which is sufficient for the reduction of the oxide of iron and of the titanic acid by the carbon of the pig iron.

The advantage of this method is that by introducing the titanium into the steel he does not increase the carbon content in the steel, but on the contrary diminishes it. On the other hand the evident disadvantage of this process (compared with the use of ferro-titanium) is that the whole steel bath must be raised to the reduction temperature of titanic oxide.

A patent relating to important details of furnace operation was recently granted to Mr. W. K. Gibboney, of the Pittsburgh Reduction Company for automatic regulation of a group of electrodes in an electric furnace, and another patent was obtained by Mr. G. O. Seward, of the Willson Aluminum Company, for the construction of a carbon holder for electrodes.

It is well known how the apparently simple reaction between silica and carbon in the electric furnace has led, in the hands of Mr. E. G. Acheson, to the four important industries of carborundum, artificial graphite, silicon and siloxicon. A recent patent of Mr. W. G. Clark relates to still another development in this field. It refers to a compound of carbon and silicon which is stated to be specially suitable for incandescent lamp filaments, being harder and more durable than carbon filaments. It is produced by passing an electric current through a carbon filament in the presence of a mixture of a hydrocarbon gas and the vapor of silicon tetrachloride. The compound is different from carborundum, being formed at a temperature lower than the fusing point of carborundum and being a conductor of electricity when cold.

BATTERIES.

Among storage battery patents recently issued there is a bunch of eight patents granted to Mr. Thomas A. Edison for his well known alkaline storage battery. One of them refers to the use of twice as many nickel grids as iron grids. As has been known for some time Mr. Edison's active iron mass is much more active electrolytically than the nickel hydroxide. The bulk of active iron need, therefore, be only half that of the nickel. It would, however, not be practical to make the pockets containing the nickel material twice as large as the iron pockets. It is best to use the same size of pockets for both active materials but to use double the number for nickel as for iron. This has been done in Mr. Edison's battery for quite some time.

The other patents refer to mechanical details of his battery and especially to three different methods for making cobalt films or flakes for admixture with the particles of active mass of nickel hydroxide.

New Telephone Patents.

RECEIVER.

A patent has been obtained by Mr. C. T. Mason, of Sumter, S. C., for a receiver, the novelty of which lies chiefly in arrangements for cementing the parts together after an adjustment has been effected. The patent has been assigned to the Sumter Telephone Manufacturing Company.

SWITCHBOARD SYSTEMS.

A development along the lines of the semi-automatic switchboard is always interesting. In this class falls the device described in a patent granted to Hr. E. A. Faller, of New York City, for a signal system. The calling party sets a selector to the desired number and starts the call. His line lamp lights and the operator picks up his line on a cord pair and receives on her register the first part of the call. This results in a signal glowing over a non-busy trunk line to the proper section for the desired party, and the cord pair is at once connected to the trunk line. This extends the signal to the receiving end of this trunk line, the operator controlling which plugs in and rings back toward the subscriber, thus not only notifying him, but also causing the remaining digits of the desired number to come in, being received by the lighting of a called lamp associated with the desired line. The connection is completed by the operator in response to this lamp. The means of accomplishing these various duties is of a nature not lending itself readily to a brief description.

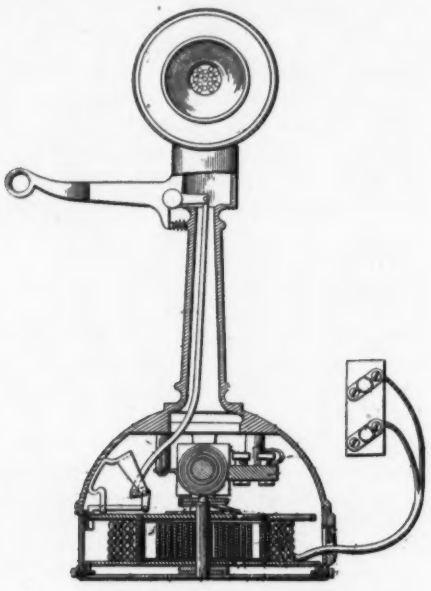
A switchboard circuit system for manual common battery working has been invented by Mr. W. A. Taylor, of Chicago,

which is based upon the peculiar properties of iron cores under the influence of rapidly varying currents. The current is fed to the line through a relay with two windings, which do not overlap. These are connected differentially and for direct currents are non-inductive and the relay is not energized. For telephone currents, however, the coils act independently and inductively. This property permits of the development of a most simple system. Mr. Taylor's patent has been assigned to the Kellogg Company.

Two patents have been granted to Mr. M. G. Kellogg upon applications of many years standing. These cover features now well known.

TELEPHONE SETS.

In the cut is shown in section a novel desk stand with a slack adjuster for the cord concealed in its base. The cord reel normally pulls against a spring. However, as soon as the hook



SHINER PORTABLE TELEPHONE.

switch rises the reel becomes locked to prevent the tension from annoying the user. Mr. W. A. Shiner, of Rochester, N. Y., is the inventor of this stand.

Mr. A. L. Brinckle, of Philadelphia, has patented a special desk stand for use with a head receiver. He omits the customary switch hook and substitutes a manually-operated push button type switch to accomplish the same results.

A message counter for desk stand instruments forms the subject of a patent issued to Mr. C. T. Bradshaw, of Philadelphia. The counter is adapted to be clamped to the upright of the stand, and a level serves to effect the counts upon the dials. Each count is accompanied by the stroke of a gong or other audible signal. A trip attached to the switch hook prevents any counting except when the receiver is off the hook.

Mr. F. R. McBerty, of Evanston, Ill., has patented a case for a portable telephone. The case is a rectangular box with a partition near the bottom. The front of this partition is hinged to swing outward into a horizontal position. The inside of the door carries a shelf and this forms with the door a V section trough into which the telephone instrument may be laid. The mere opening or closing of the door conceals the instrument or exposes it for use. The Western Electric Company has obtained this patent by assignment.

Letters to the Editors.

Gas Engine Efficiency.

To the Editors of Electrical World:

Sirs:—In the citation of comparative engineering data of such character as gas engine efficiency there is an extremely wide opportunity for misunderstanding unless the specific basis of calculations accompanies the data given; for if this is not done the data may create in the minds of those who are not thoroughly conversant with the details of such calculations, entirely erroneous impressions. In an article in one of your recent issues the following statement was made in connection with Diesel engine efficiency:

1. A good slide valve steam engine utilizes only 5 per cent. 2. A plain Corliss engine only 6 per cent. 3. A compound condensing engine only 8 per cent. 4. A reheating compound or triple expansion engine only 12 per cent. 5. The best oil engine (explosion type), 16 per cent. 6. The best gas engine (explosion type), 19 per cent. 7. The engine to which the article refers utilizes fully 38 per cent of the fuel consumed.

As to the steam engine efficiencies, one naturally infers from the verbiage that the efficiency of the prime mover alone is meant, yet the figures are so low that it is plain that the complete steam plant is referred to, i. e. the efficiency from coal pile to engine shaft. If this is the case, the figures are perhaps not over-conservative. But in quoting 38 per cent for the *corresponding plant* efficiency of the engine described in the article I believe this comparison is invalid.

An engine efficiency of 38 per cent is equivalent to a heat consumption of 6,455 B.t.u. per hp-hour.

$$Efficiency = \frac{2{,}545}{B.t.u.\ per\ hp\text{-}hour}$$

Is the final statement above on a basis of brake horse-power, i. e., that the engine is capable of delivering one b.h.p. per hour on a heat consumption of 6,500 B.t.u.?

Perhaps this heat efficiency is *intended* to apply only to indicated horsepower. Assuming 70 per cent gross mechanical efficiency, which is conservative considering pump work, the heat consumption of the engine would be 9,230 B.t.u. per b.h.p. hour, which corresponds to a thermal efficiency of 27½ per cent upon a b.h.p. basis.

Now the most casual reader of the technical press will have observed that the heat consumption of a modern high grade gas engine, of large capacity, does not run far from 10,000 B.t.u. per hp at rated load; and furthermore, 10,000 B.t.u. per brake horsepower, not per *indicated* horsepower. Any number of builders, both in this country and abroad, will guarantee close to this figure, and many tests have shown that it has been obtained. A heat consumption of 10,000 B.t.u. per b.h.p. is equivalent to a little over 25 per cent brake thermal efficiency at the shaft. Assuming a conservative figure of 80 per cent mechanical efficiency, this is equivalent to a thermal efficiency of nearly 32 per cent based upon i.h.p.

There are so many tests on record, made by undisputed authorities, showing the gross brake thermal efficiency of a good four-cycle engine, to range between 23 to 25 per cent under ordinary working conditions, as to render this an incontrovertible fact. I do not deny that 38 per cent gross efficiency might be obtained under certain conditions *within the cylinder* of a gas engine owing to the effect which high compressions have upon engine economy. But in drawing comparisons between the type of engine for which the claim is made and the modern high grade gas engine by the figures quoted above, I believe the comparison has been overdrawn (perhaps beyond the elastic limit). Indicated horsepower is not the proper basis, in commercial work, for computing the efficiency of internal combustion engines, particularly when power costs are quoted in terms of kw-hour.

The crux of the whole subject lies in the definition of efficiency, and I do not believe it justifiable to cite on the one hand, brake efficiencies that are, to say the least, extremely low, and, on the other hand, indicated efficiencies that have been reached only in exceptional cases. I have before me a test made by an eminent German authority upon a small engine of the type to which this criticism refers, in which the friction and pump work amounted to over 40 per cent of the indicated work, giving a maximum mechanical efficiency of less than 60 per cent at somewhat under full load. Another test on a larger engine shows a maximum mechanical efficiency of about

70 per cent, the gross or brake thermal efficiency on a b.h.p. basis ranging from 23 per cent to 26 per cent.

Perhaps it has occurred that higher brake efficiencies have recently been obtained by the engine in question, and if a heat consumption of 6,500 B.t.u. per b.h.p. hour *is* being obtained, I am sure that the fact is not generally known. The manufacturers would, I believe, confer a great favor upon engineers by making public the tests from which the high efficiencies noted above have been derived.

PITTSBURG, PA. J. R. BIBBINS.

Variable-Pole Induction Motor.

To the Editors of Electrical World:

SIRS:—With reference to the description in the ELECTRICAL WORLD of June 16, 1906, of Mr. B. G. Lamme's new single-phase motor, allow me to call your attention to the fact that I applied for a British patent for an exactly similar motor on the 16th of September, 1903, and that since that time machines of this type have been manufactured by the Sandycroft Foundry Co., Ltd., of Chester, England. The number of the British patent is 19,948.

CHESTER, ENGLAND. LOUIS J. HUNT.

Resistivity Temperature Co-efficient of Copper.

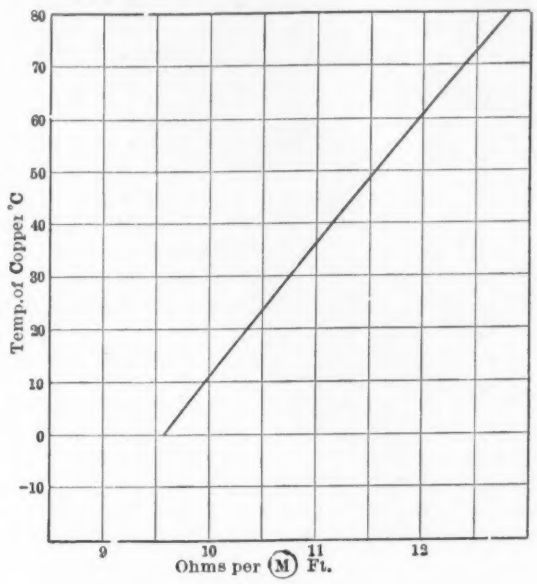
To the Editors of Electrical World:

SIRS:—In your issue of June 30, 1906, Dr. A. E. Kennelly published a short article on "The Resistivity Temperature Co-efficient of Copper." The following, which is practically the same method, is perhaps a little easier to follow, and applies to any conductor, no matter what may be the relation between temperature coefficient and temperature.

The accompanying curve shows the relation between temperature of conductor and resistance of conductor per circular mil-foot. In what follows this curve is applied to the examples worked out in the aforementioned article:

"A dynamo armature winding has a resistance of 0.23 ohm at an initial room temperature $t = 25°$ C., and after carrying a load increases its resistance to, say, 0.271 ohm. What is its temperature elevation?"

From the curve we find: At 25° C. the resistance of copper



TEMPERATURE CURVE.

is 10.55 ohms per circular mil-foot. At 0° C. this value is $\frac{10.55 \times .271}{23} = 12.42$; the temperature from the curve for this resistance is 71° and temperature rise 71 — 25 = 46° C.

"A copper wire has a resistance of 400 ohms at 11° C. What will its resistance be at 55° C.?"

At 11° C. the resistance in ohms per circular mil-foot is 10.02, and at 55° C. is 11.75 ohms. The resistance at 55° is, therefore, $\frac{400 \times 11.75}{10.02} = 470$ ohms.

NORWOOD, OHIO. A. MILLER GRAY.

DIGEST OF CURRENT ELECTRICAL LITERATURE

Dynamos, Motors and Transformers.

High-Speed and High-Voltage Direct-Current Dynamos.—HOBART.—An article on the use of interpoles in direct-current dynamos for obtaining better commutation at high speeds such as are used in combination with steam turbines. The writer's practice is to proportion the commutating pole to overcome the reactance voltage, and without reference to overcoming armature interference; hence, the commutating pole is as short in the direction of the shaft as is permitted by this plan of procedure. Aside from the question of overcoming the reactance voltage, there is also the difficulty of avoiding undue heating of the commutator without employing excessive length. The diameter of the commutator must, in the first place, be so small as to avoid immoderately high peripheral speeds. As is well known, the lower the peripheral speed the better is the performance of carbon brushes under otherwise equal conditions. With carbon brushes it is desirable also to restrict the current density at the brush surface to a low value. Hence the smaller the diameter for a given amount of current to be collected, the longer must be the commutator. Graphite brushes, copper brushes, or some new development, may ultimately improve matters in these respects, but in the meantime the smaller the current to be collected, the more satisfactory may be the design. The author has worked out a large number of high-speed, direct-current dynamo designs for various outputs and voltages, and points out that the difficulties of the design decrease with increasing voltage and that a 4,000-kw, 2,000-volt, 500-r.p.m., direct-current design gives every indication of being a sound proposition. When designed for high pressures at the commutator, the abnormal appearance which has come to be associated with the direct-current dynamo connected to steam turbines gives way to a well-proportioned design. As an instance of a design for moderately high voltage, speed and output, he describes a 1,000-kw, 1,000-volt, 1,000-r.p.m.

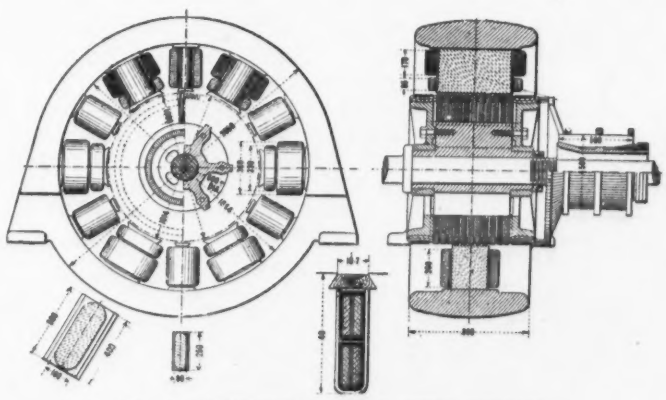


FIG. I.—SECTIONS OF HIGH-SPEED DYNAMO.

dynamo. An outline sketch of the machine is shown in Fig. 1, the dimensions being given in millimeters. The external peripheral speed of the armature is 52.5 meters per second, which is not excessive. The peripheral speed of the commutator is 26 meters per second. Carbon brushes are employed. The inter-

poles are placed equidistantly between the main poles and a diverter rheostat is used in parallel with the interpole windings which is adjusted to give good commutation at all loads. Detailed figures are given of the whole design.—Lond. *Elec.*, June 29.

Lamps and Lighting.

Influence of the Wave Form on the Operation of Arc Lamps.—Zorawski.—In an extensive municipal three-phase system it was found that all arc lamps installed in stores or halls made so much noise that they had to be replaced by incandescent lamps. At first it was thought that some unsuitable design of the arc lamps was responsible for this, but experiments showed that all types, whether with open or enclosed arc, behaved the same way. By the station officials it was required that all arc lamps were to be provided with ohmic resistances, choking coils not being permitted. It was finally found that the wave form of the supply e.m.f. was at fault. Fig. 2 shows the wave form obtained

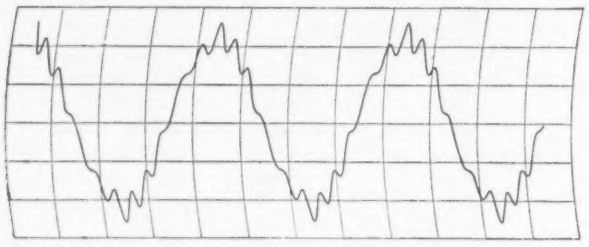


FIG. 2.—WAVE CHART.

from a 400-kw dynamo at half load, plotted by means of an oscillograph. In order to find whether this was the only reason, the ohmic resistances were replaced by choking coils which by means of their self-inductance made the curves of the e.m.f. more regular. With sufficiently large resistances, satisfactory results were obtained.—*Elek. Zeit.*, June 28.

Power.

Exhaust Steam-Driven, Three-Phase Haulage Plant.—Maurice.—A paper read before the British Institution of Mining Engineers. The exhaust steam of a continuously-running engine was first utilized by Parsons, who coupled a turbo-alternator of his design with the exhaust steam from the low-pressure cylinder of a compound engine. In the case of winding engines the intermittent nature of the exhaust steam renders impossible the direct coupling of a low-pressure turbine. Rateau has overcome this difficulty by the use of a heat accumulator, the purpose of which is to take off the intermittent steam exhaust from the primary engine, to accumulate it, to keep it under practically constant pressure and to supply it into the secondary engine just as it could only otherwise be done by direct supply from the boilers. For this purpose the steam escaping from the winding engine passes through a large steam reservoir where the heat is accumulated from the steam by the help of water and distributed metal, and the water is evaporated again during the time that no fresh exhaust steam can be supplied. This freshly raised steam is given to the secondary engine until fresh exhaust steam can go directly through it. In the Hucknall installation, which is described in the paper, the accumulator contains 50 tons of scrap iron pit rails assembled horizontally and in parallel layers. Their purpose is to help in the accumulation of the heat, to take over the heat very quickly and to give it back very quickly.—Lond. *Elec.*, June 22.

Live Steam-Heated Feed Water.—Wilkinson.—A paper read before the British Municipal Electrical Association on live steam-heated feed water and its effect on the output and efficiency of steam boilers. The general conclusions of the author are as follows: Boiler house plant can with advantage be reduced in size, and the duty increased with a saving in capital, working expenses and maintenance, and this without sacrifice of efficiency. In a high-duty boiler plant the heating of feed water to the steam temperature (or to a temperature closely approximating thereto), and the actual generation of steam should be treated as separate and distinct operations, each demanding its own special plant. The terminal temperature of the flue gases leaving the steam generators will be higher, the residue down to the chimney temperature being taken up by the feed water and possibly air heating plant, provided with scrapers to remove the soot and flue dirt from the heating surfaces. Intense heat applied to a restricted area curtails the area of equilibrium within the boiler. High duty demands a more extended distribution of the furnace heat than is generally obtained at present. For high duty with efficiency, clean boilers, good water and steam temperature feed water are essential conditions. Boiler house plant designed for low duty (say, from 3 lb. to 5 lb. of water per square foot of heating surface) cannot be fitted for efficient high duty without considerable modification, such as the enlarging and rearranging of the furnaces, the cutting out of the "tail end" of the heating surface, and the providing of a plant for taking up the heat from the gases emitted from the boiler flues and for transferring the same to the feed water and air heaters.—Lond. *Elec.*, June 29.

Electrically-Driven Air Compressors.—Thompson.—A paper read before the British Institution of Mining Engineers on the use of electrically-driven air compressors at the Ouston Colliery. It was found at that mine that electricity at the coal face was out of question, owing to the amount of gas given off by the Busty seam. On the other hand, a well-equipped modern electric station had been put down at the pit. It was then concluded that it would be cheaper to utilize the plant for generating electric current to be transmitted to electrically-driven air compressors than to put down at the bank, in addition, a steam-driven air compressor plant and to conduct air to the face in the usual way. Moreover, electric cables can be placed in the shaft and along the roadways more easily than bulky air pipes. The installation is described; in two tests efficiencies of 62 and 60 per cent of the plant were found, which is thought to compare favorably with that of any steam-driven air compressor plant.—Lond. *Elec.*, June 22.

Traction.

Operating Cost of Electric Railways.—Knowlton.—An analysis of the operating costs and revenues of five representative electric railways. These are the street railway systems of Boston, Worcester, Springfield and Pittsfield, and the interurban line between Boston and Worcester. In the first table the author gives a general survey of the earnings and expenses of the five systems. These are then reduced to the operating cost and revenue per passenger as follows:

	Boston Elev.	Worcester Consol.	Spring-field.	Pitts-field.	B. & W.
	(All figures are in cents.)				
Gross earnings per passenger	5.00	5.00	5.00	5.00	5.00
Other earnings	.14	.06	.07	.00	.06
Total earnings from operation	5.14	5.06	5.07	5.00	5.06
Operating expenses	3.50	3.02	3.60	3.57	2.59
Net earnings from operation	1.64	2.04	1.47	1.43	2.47
All other income	.02	...	...	...	...
Total income	1.66	2.04	1.47	1.43	2.47
Total charges on income	1.33	1.33	.76	.79	1.28
Net divisible income	.33	.71	.71	.54	1.19
Dividends and surplus	.33	.71	.71	.54	1.19

The author further gives tables of the volume of traffic and the car mileage of each road and the principal financial items of expense per mile of track and per car mile. The financial items per car mile are as follows:

	Boston	Worcester	Spring-field.	Pitts-field.	B. & W.
		(All figures are in cents.			
Gross earnings	26.4	27.1	21.1	23.5	24.7
Operating expenses	17.9	16.1	15.0	16.7	12.6
Net earnings	8.5	11.0	0.1	6.8	12.1
Wages	8.0	5.7	5.5	5.0	3.9
Motive power	1.8	3.7	2.8	5.1	3.3
Car equipment repairs	0.7	0.8	1.2	2.6	1.0
Maintenance of way	1.6	0.5	1.3	1.0	0.5
Maintenance of line	0.3	0.2	0.3	..	0.1
Legal expenses	0.6	..	0.1	0.2	..
Insurance	0.3	0.4	0.1	0.1	0.4
Taxes	2.1	2.1	1.6	1.3	1.8
Dividends	4.1	3.8	3.2	2.2	5.6

Of the general conclusions which the author draws the following may be mentioned: The cost of street railway operation is very high in large cities, especially in the direction of the number of employes necessary and the maintenance of way. Although the cost of motive power per mile is largest in Boston it is least per car mile in that city. The rides per capita increase with

the population as does the traffic density. The larger the city, the higher are the wages per car mile. The profits above the cost of operating a street railway system in a small city are by no means inordinately great at the present time, and while a large urban street railway system properly handled ought to be exceedingly prosperous judged by the traffic density, it requires the most careful management to keep the expenses down to reasonable amounts. Fixed charges, and especially taxes, amount to enormous totals in the operation of a great system; legal expenses and damages, the cost of inspection and wages are bound to be high.—*Eng'ing Mag.*, July.

Rail Joints.—BUCHWALD.—An illustrated discussion of the requirements which must be fulfilled by rail joints for street railways, together with a brief illustrated description of the principal joints used on German street railways.—*Elek. Zeit.*, June 28.

Installations, Systems and Appliances.

Leakage Indicators.—WALKER.—A paper read before the British Institution of Mining Engineers on the capacity current and its effect on leakage indications on three-phase electric systems. Leakage from any cable is caused by deterioration of the insulating substance. The deterioration, whatever its cause may be, reduces the capacity of that cable, and offsets the balance between the capacity currents of the three cables. Hence, any instrument that will denote a difference between the capacity currents of the three cables, will indicate that there is a leak on one of the cables. The author then describes various leakage indicators.

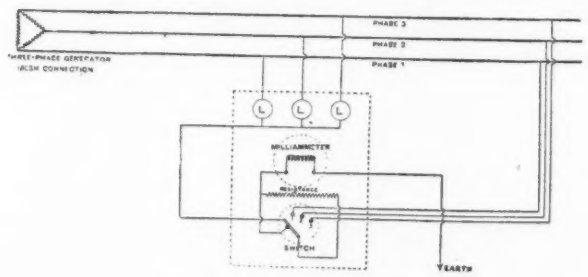


FIG. 3.—LEAKAGE INDICATOR.

In the Ferranti instrument (Fig. 3) a connection is taken from the cable of each phase to one terminal of a lamp, and the other terminals of the lamps are connected together, thus forming the neutral point. From this a connection is taken to a stop on the switch, which, when the apparatus is in use under normal conditions, is connected by the switchboard to a wire leading to the milliammeter. When the apparatus is to be used to test an individual cable, the switch arm is moved from the neutral point to the stops marked 1, 2 or 3 and from the switch arm a connection then leads through a resistance to the milliammeter, and thence to earth, each cable showing its own capacity current in turn. Another instrument devised by Nalder Bros. and Thompson uses continuous current superposed upon the alternating current, whereby the direct current indicates the leakage by means of instruments which respond only to direct current. The arrangement is shown in Fig. 4. There is a small continuous-

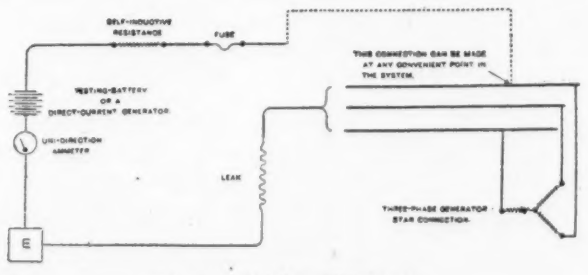


FIG. 4.—LEAKAGE INDICATOR.

current generator constructed to give a pressure of 500 or 1,000 volts, and a low-reading ammeter constructed to respond only to continuous currents; and in circuit with these are what is termed a self-inductive resistance and a fuse. The inductive resistance consists merely of a coil of wire wound on an iron core, the length and dimensions of which are calculated in accordance with the periodicity of the alternating circuit to which it is to be applied, so that any alternating current passing into the circuit of which it forms a part is automatically neutralized or choked, and is not able to reach the ammeter referred to above, the fuse protecting the meter from accident. One terminal of the circuit, made up of the small generator, the ammeter, the self-inductive resistance and the fuse, is connected to earth, E, and the other end of the circuit is connected to any convenient point in the alternating-current system. As the three cables of the three-phase system are connected at the generator, and also, when the apparatus is working, at the motors and lamps, a connection to any one of the cables is practically a connection to all, and so long as the insulation of all three cables and all parts of the system from earth is above a certain figure no current will pass through the testing circuit. If a leak arises at any part of the three-phase system the circuit with the testing system is completed by way of earth, and the ammeter will show the leakage or the resistance of the whole system, according as the instrument is graduated in milliamperes or ohms. In place of the small generator, which must, of course, be driven during the whole time that the testing circuit is in use, it is proposed by the makers to use a battery of dry cells, giving a pressure of 125 volts. One great advantage of this testing apparatus appears to be that it avoids the complaint made against other apparatus, in that, if an equal leak occurs in each of the three cables, provided that the leak is in each case to earth, the ammeter will show the resistance of the whole of the leaks by the fact that each leak will increase the current passing through the instrument and will increase in deflection. It also has the advantage that it is applicable to two-phase services, in which the algebraical sum of the capacity currents, when the capacities of all the cables are equal, is not equal to zero. In the discussion which followed Pope said that although the leakage indicators described appeared very ingenious, they failed in one detail, namely, that they would not act in the case of a three-phase system with an earthed neutral. Such earthing is prescribed by the British Board of Trade. While he knows of no exact instrument for measuring the leakage in such a case, a very simple arrangement could be made which would, at any rate, tell whether here was a fault in the mains system where the neutral was earthed. The Board of Trade asked simply that the neutral be earthed at one point, and this fact, he thought, allowed the arrangement in Fig. 5 to be employed for indicating a fault, if

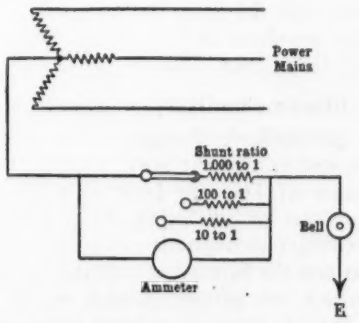


FIG. 5.—LEAKAGE INDICATOR.

not its value. The lower values of the shunt could be used for testing purposes after the bell had indicated that a fault existed. —Lond. *Elec.*, June 22. In a communication Edgcumbe refers to the arrangement of Pope for the earthed system shown in Fig. 5, which is stated to be practically identical with one supplied by his own firm, with the difference that in the latter device there is provided a 100-amp. short-circuiting switch, which, on the occurrence of an earth, cuts out the instrument and rings a warning bell. The writer thinks that with Pope's arrangement the bell would be instantly burned out in the case of a serious fault, and the earth circuit thereby opened. Moreover, unless the ammeter switch were left continuously on the 1,000:1 shunt the ammeter would be almost inevitably damaged, while, on the other hand, when so shunted the instrument would be so unsensitive that almost nothing short of a dead earth would be noticeable. Both of these objections are overcome by the use of the short-circuiting switch.—Lond. *Elec.*, June 29.

Municipal Electric Association.—A full account of the 11th annual convention of the British Incorporated Municipal Electrical Association, recently held in Kingston-on-Thames. From the presidential address of Edgcome the following note on municipal wiring is interesting. "Wiring of consumers' premises might be carried out to the satisfaction not only of the local authorities, but also of the general body of contractors, if the local authorities, having obtained powers for carrying out such work, were content to act only as what might be described as bankers to their electricity consumers. Local authorities, having entered into an agreement with new consumers to enable them to spread the cost of the work over a number of years on the basis of a deferred payment system, and having ascertained the requirements of such consumers, should prepare a specification of the work required and, instead of then proceeding to carry out the work, should obtain tenders from suitable contractors, and having supervised the carrying out of such work, should be prepared to make the necessary payments to the contractor on the completion of the work." Baynes presented a paper on steam turbines in which the principal types were described. Two papers by Fedden and Bishop, respectively, dealt with the commercial development of the electric stations, and such matters as advertising, circularizing, canvassing, exhibitions, "use of the press" (local press), etc. Other papers presented at the convention are or will be abstracted in the Digest.—Lond. *Elec.*, June 22 and 29.

Electrophysics and Magnetism.

Electron Theory of Matter.—Schott.—A mathematical paper on the electron theory of matter and the explanation of fine spectrum lines and of gravitation. The author's chief conclusions are as follows: In order to account for the definiteness of atomic structure, as evidenced by the fineness of the spectrum lines, on an electron theory without the assumption of forces between electrons other than electromagnetic, it is necessary and sufficient to assume that the electron expands at a certain slow rate. In order to satisfy the principle of the conservation of energy it is necessary to assume that the expansion is resisted by an internal stress, which in the simplest case is a hydrostatic pressure. In order to explain this pressure in accordance with the spirit of the electron theory, that is, without action at a distance, we must assume that it is due to the action of the ether on the electron. The reaction of the electron on the ether produces a pressure in the ether at the surface of the electron; if this is not exactly balanced by the pressure at infinity the electron expands, presses back the ether and acts like a source in a liquid. Hence electrons gravitate towards each other, as do sources in a liquid.—*Phil. Mag.*, July.

Electrochemistry and Batteries.

Fixation of Atmospheric Nitrogen.—A full abstract of a series of papers presented at a recent convention of the German Bunsen Society. A paper of Foerster dealt with the industrial importance of the problem of producing nitrogen oxides and nitrates by electric discharges through air. A paper by Nernst discussed the equilibrium and the formation velocity of nitric oxide. When electric discharges are passed through air the combination of nitrogen and oxygen proceeds only to a certain maximum concentration of NO, and for industrial purposes it is important to make this concentration as high as possible. The higher the temperature the greater the concentration of NO, but since the cost of producing high temperatures increases with the temperature there will be a point at which the commercial efficiency is a maximum. After equilibrium has been reached it is important to cool the gas mixture as quickly as possible so as to "freeze" the original equilibrium and prevent redestruction of the nitrogen oxide formed. Fundamental data are given on which a theory of the problem may be developed on the basis of modern physical chemistry. Nernst considers it to be improbable that a gas mixture may be obtained on a commercial scale containing more than three per cent NO, since in the removal of the gas mixture from the arc the cooling is not quick enough to prevent the decomposition of NO. A paper of Foerster then gave a review of the various processes which have been proposed and tested. The process of Birkeland and Eyde is at present commercially successful and most promising, but Foerster thinks that the spark discharge would be the ideal thing (instead of the arc discharge used by Birkeland and Eyde). Bradley and Lovejoy used the spark discharge, but they needed too much of complicated apparatus. Foerster thinks that if electrical engineers would invent cheap, durable condensers, the spark discharge would become the ideal method for the fixation of atmospheric nitrogen. From the data of the Norwegian plant of Birkeland and Eyde, Foerster concludes that the one and one-half million tons of Chili saltpetre consumed per year in the world could be produced by some two and a half million horse-power. Incidentally he remarks that of these 500,000 hp could be produced by utilizing in gas engines the waste gases of the blast furnaces in the iron districts of Rhineland, Germany, alone. A paper by Le Blanc deals with the analytical estimation of NO in air. The final paper by Klandi discusses the best commercial methods for treating the NO diluted in air for the production of nitric acid and nitrates.—*Electrochem. and Met. Ind.*, July.

Lines of Currents in Storage Batteries.—Schoop.—The first part of a paper giving the results of an experimental study on the course of the lines of current in electrolytic cells. The author determines experimentally the equipotential curves in an electrolytic cell by means of an "analyzer," which consists principally of two small electrode plates or points connected to a suitable sensitive galvanometer or millivoltmeter. By putting the analyzer into the electrolyte at a certain point, it suffices to revolve it around its axle of symmetry until the galvanometer shows no deflection. The two electrodes of the analyzer are then on an equipotential curve. Fig. 6 shows a simple arrangement of test in which a tray is filled with hot paraffin to a small height and then an electrolyte is poured in. The analyzer ends in two platinum wires in the form of a fork at the end of a glass tube, connected with the terminals of a telephone. Alternating current or a pulsating current is used. The lines of current to be studied pass between two nails at the opposite sides of the tray. The analyzer is revolved around its axle until the sound in the telephone becomes minimum. Then the two platinum points are pressed into the paraffin. In this way dots are obtained in the paraffin giving directly the direction of the equipotential curve. When the equipotential curves have been traced in that way in the paraffin, the lines of current are plotted simply by making them perpendicular at every point to the equipotential curves. The subject is of great importance for storage batteries. The author recalls the fact that the loss of capacity in spongy lead plates of storage batteries which have been in use for some time in the lower parts of the plates is greater than (and in some cases twice as great as) in the upper parts. This is due to the straying of the lines of force. The article is to be concluded.—*Electrochem. and Met. Ind.*, July.

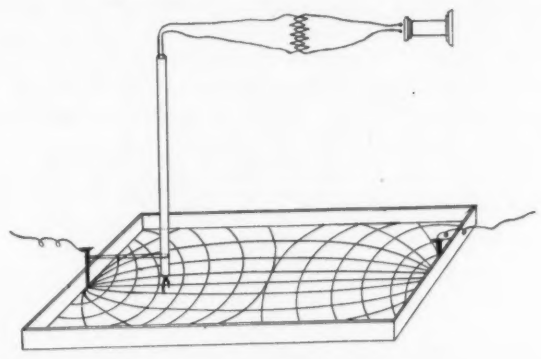


FIG. 6.—ARRANGEMENT OF TEST.

Molecular Constitution of Aqueous Solutions.—Sutherland.—In the study of aqueous solutions much attention has been paid to the ionization of the solute; the present author discusses the equally important changes in the solvent—water. According to him liquid water consists of a mixture of tri-hydrol $(H_2O)_3$ and di-hydrol $(H_2O)_2$ and a solute causes a dissociation of tri-hydrol into di-hydrol whence the abnormal behavior of aqueous solutions. In the present paper the author endeavors to calculate the effect of solute on solvent and thus to arrive at a tolerably complete conception of the molecular constitution of aqueous solutions.—*Phil. Mag.*, July.

Sterilizing Water by Ozone.—HALBERTSMA.—A note stating that the ozone plant designed to treat a portion of the water supply of Wiesbaden has not been abandoned, but is merely being held in reserve. As the ozonizing process is rather an expensive one and is made so principally by the many bacteriological tests being made necessary for the proper control of the working of the plant, the ozone plant will be used only in certain exceptional cases where unsafe water must be sterilized.—*Eng'ing News,* July 12.

Electrotyping.—COWPER-COLES.—The first part of an illustrated serial describing rapid methods for producing electrotypes.—Lond. *Elec. Rev.,* June 15.

Units, Measurements and Instruments.

Standard Lamps.—LIEBENTHAL.—An article on photometric tests of the German Reichsanstalt on the ratio of the candle-power of the Hefner lamp to the "10-cp" Pentan lamp and the carcel. According to the definition of the reichsanstalt, one hefner candle is the candle-power of the hefner lamp for humidity of 8.8 liters per cubic meter of dry air free from carbonic acid, and at 760 mm. mercury barometer. The candle-power of the 10-cp pentan lamp at 8.8 liters humidity and 760 mm. was found to be 11.0 hefner candles; the candle-power of the 10-cp pentan lamp at 10 liter humidity and at 760 mm. mercury 10.9 hefner candles. In the National Physical Laboratory of London the candle-power of the pentan lamp at a humidity of 10 liters (which is the average value of London) is considered as the standard. The candle-power of the carcel at a humidity of about 8.8 liters was found to be 10.8 hefner candles.—*Jour. f. Gesbeleuchtung,* June 30.

Miscellaneous.

Electricity in Fire Fighting.—MOLTKE.—A paper read before the recent convention of the Association of German Electrical Engineers. The speaker discussed the historical development of our fire departments and dwelt on the importance of electric fire alarm and signal systems which are now highly developed. Electric lighting of engine houses is also well provided for, but something should be done for devising a practical storage battery lamp to be used on engines and fire trucks; electric bells on such trucks should also be improved. The author thinks that engines and trucks will be driven in future electrically, and that in large cities even a saving may be accomplished compared with horse traction. According to German statistics fires due to faults in electric installations were less than two per cent of the total and have decreased in spite of the great expansion of electrical installations. Among returns from many German cities the author was informed from the fire department of Krupp of Essen that a man holding the nozzle of a hose was hurt when the water came in contact with an electric high-tension wire. Extensive experiments of the author and Bohnenberger on this point (which are described in detail together with illustrations) show that such a danger really exists. To protect firemen it is necessary to earth the nozzle of the hose, or if this is not possible the man should stand on insulated ground or he should wear rubber gloves.—*Elek. Zeit.,* June 28.

Effects of Lightning.—STARKEY AND KELVIN.—Barber Starkey, in a letter to Lord Kelvin, describes remarkable results of a discharge of lightning upon an oak tree. A large number of shreds of wood, probably not fewer than two or three dozen, and varying from 1 to 3 ft. in length, and of an irregular breadth of 1/16 to ¼ of an inch, were torn out of the bole of the tree, and remained with one end fixed in the ground to a depth of 1 in. or more, standing in a more or less nearly vertical position inclined towards the tree at a distance of about 15 ft. from the bole of the tree on the west side. These irregular shreds were so light and flexible that the act of falling could not have placed them in the position described. "Apparently they had been sucked into the ground. Could this have been caused by any electrical action?" Lord Kelvin's answer is as follows: "I think it probable that each shred, during its passage through the air from the tree to the earth, was kept stiff and straight by mutual electric repulsion between its own parts, and was shot into the earth as an arrow might be in virtue of its velocity before touching the earth. I scarcely think that after it touched the earth there could have been enough of electric attractive force to 'suck it into the ground' much farther than its own velocity and inertia took it. The velocity which it acquired after leaving the tree was certainly given to it initially by electric repulsion from the tree, due to large difference of potential between the tree and the earth. During its flight it must have been strongly electrified, and must have experienced, therefore, an oblique force, becoming nearly perpendicular to the ground before it struck. It is quite certain that each shred must have been strongly electrified (whether vitreously or resinously we cannot say) at the instant of its leaving the tree."—*Phil. Mag.,* July.

Blast Furnace.—RICHARDS.—In his serial on metallurgical calculations which deals at present with the blast furnace, the author discusses the fundamental problem of blast furnace practice, namely, the heat balance sheet of the blast furnace.—*Electrochem. and Met. Ind.,* July.

BOOK REVIEWS.

CAM CONSTRUCTION. By George Jepson. New York: D. Van Nostrand Company. 59 pages, 37 illustrations. Price, $1.50.

This well-arranged and attractive book is printed in large, clear type and embellished with exceptionally good illustrations. The methods given for construction of cams are simple, but complete in all details. Almost every variety of cam is given due attention, making it a valuable work on this subject.

REPORT OF THE ELECTRIC RAILWAY TEST COMMISSION TO THE PRESIDENT OF THE LOUISIANA PURCHASE EXPOSITION. New York: McGraw Publishing Company. 621 pages, 209 illustrations. Price, $5.00.

This finely prepared and published report constitutes one of the permanent records of the work of the St. Louis Exposition. A number of fine traction exhibits were made at that exposition, and it is a fortunate circumstance that arrangements were made for a thorough test of the apparatus, under service conditions, by a corps of engineers and assistants specialized in this branch of electric power application.

The tests include electric cars for urban and suburban service, acceleration tests, braking tests, storage battery locomotives, alternating-current losses in track, train resistance and air resistance. The results of the various tests have been carefully worked up into curves and tables, in such a manner as to be readily assimilable by the railroad engineer.

This is the first volume to publish a complete set of data concerning alternating-current losses in tracks and track conductors. This information is most timely, and, if only on this account, the book would be most welcome on the table of the traction engineer. The book will be greatly appreciated as a reference volume, and a text-book on electric railway systems. It reflects credit upon all connected with the extensive work covered by the tests.

The New Siemens-Halske Works in Berlin.

The Siemens-Halske Company was formed in 1847, Werner Siemens being a lieutenant of artillery and Halske a mechanic. They had a small shop only, but bought a larger house in 1852 in Markgrafenstrasse in Berlin. This works was first devoted to telegraphy and cable. After the invention of the dynamo and the commercial introduction of electric lighting, embodying many Siemens-Halske inventions and patents, the old house in Markgrafenstrasse became too small for all the work of the company, and several new shops were erected in Charlottenburg for cables, dynamos, arc lamps, incandescent lamps, railway block signals, etc.

The old works in Markgrafenstrasse remained devoted chiefly to what the Germans call "Schwachstromtechnik," that is telegraphy, telephony, measuring instruments, etc. All of the chief departments of these works increased so much that in 1905 each one was bigger than the whole works 20 years before. While there were 800 workmen in 1895 the number had increased in 1905 to more than 4,000. Necessarily, the whole works became

too small. Hence, new works have been erected outside of Berlin between that city and Spandau, near the Jungfernheide. The official name of this new works is Wernerwerk. The removal from Berlin to the new works was completed in 1895.

The whole equipment of the new works and all its chief departments is described in a beautiful catalogue just issued. The chief departments are telegraphy, electric signals, especially for use on board ship; telephony, fire alarms, measuring instruments, electrochemistry, water meters, cables for telegraphy and telephony. Much of the special apparatus mentioned in the catalogue is highly interesting, like the electric apparatus for transmission of signals on board ship. Many of the instruments are known to our readers from papers of Prof. Raps, all of which have been duly noticed in the Digest.

As an indication of the progressiveness of the company, the department of electrochemistry may be mentioned. Some of its specialties are apparatus for the electrolytic production of hypochlorites (bleaching liquors), ozone apparatus for sterilizing water (such portable ozone apparatus having been used in the recent Russian-Japanese war to provide good water to the army); the Kjellin induction furnace for making high-grade steels, and the process of fixation of atmospheric nitrogen in the form of calcium cyanamide, which may be used directly as fertilizer. A large plant using this process is now in operation in Italy.

Air Deflector for Electric Fans.

The accompanying illustration shows an air deflector for use with electric fans, which is designed to keep the air constantly circulated, not in one spot, but over a large area. When the draught from the fan is too direct and the volume of air is

AIR DEFLECTOR FOR FANS.

too great and not sufficiently diffused throughout the room, there exists a frequent cause of hot weather colds, bronchial and catarrhal troubles. The air deflector shown herewith has been developed with the view of eliminating this defect. The deflector is made by the Henry D'Olier Company, Philadelphia.

Portable Voltmeters and Ammeters.

The accompanying illustration shows a type of portable electrical measuring instrument which the American Instrument Company is now offering to the public. These instruments are of the permanent-magnet moving-coil type. Damage in shipment, or from jars during continued service is overcome by the use of cylindrical steel pivots journaled in the best grade of watch jewels, and friction errors are thereby eliminated. The moving systems combine light weight with extreme stiffness and, with the method of pivoting already noted, the moving coil cannot come in contact with the pole pieces, or with the cone, of the magnetic system. Zero errors are avoided by the construction employed for taking current into and out of the moving coils and by the use of very strong controlling springs which is permitted by the selection of a winding for the moving coi. giving a very large torque per ampere.

The series resistance in the voltmeters is wound so as to be perfectly non-inductive and each instrument has a negligible temperature coefficient. All voltmeters are adjusted to a uniform resistance of 100 ohms per volt, and therefore when multipliers are used they can be interchanged. The portable voltmeters are self-contained up to and including 750 volts; any range beyond that can be provided for by the use of external multipliers.

Ammeters are self-contained up to and including 200 amperes. When it is desired to use one ammeter with several ranges, the plan adopted is to employ a milli-voltmeter with separate inter-

PORTABLE VOLTMETER.

changeable shunts. Each milli-voltmeter with its leads has a resistance of exactly 1 ohm and will give full scale deflection with a potential difference of 50 milli-volts. All ammeter shunts are adjusted for a potential drop of 50 milli-volts at full load. Consequently any instrument can be used with any shunt, or any number of shunts with one instrument. This is a new feature that will be highly appreciated by engineers who wish to make current measurements through a wide range of values.

These instruments are made in two types, in one of which iron shields are used inside of the wooden case for protection against stray magnetism, while in the other type the iron shield is lacking, and in consequence the instruments are lighter in weight and somewhat smaller in size.

The factory of the American Instrument Company is located in Newark, N. J., but the general sales office is at 1114 Chestnut St., Philadelphia, where Mr. James G. Biddle, president as well as general sales agent of the company, makes his headquarters.

Raising the Efficiency of Hydro-Electric Power Units.

The Reliance Works of the Allis-Chalmers Company, of Milwaukee, presents a scene of activity unprecedented in the manufacture of hydraulic turbines. There are at the present time, under construction and in various stages nearing completion, no less than 43 hydraulic turbine units, aggregating 166,000 hp, for shipment to various portions of the United States, Canada and Mexico. The electrical development of the past few years has been accomplished almost entirely by electrical engineers and principally in conjunction with the steam engine as prime-mover. That fact has in itself been a serious drawback to the development of proper designs for hydro-electric installations, as it has too often led the electrical engineer to call upon the hydraulic engineer to fulfill requirements which were arbitrarily fixed and not consistent with the highest efficiency obtainable under given conditions. On the other hand, water turbines were formerly built in catalogue sizes, from certain standard designs, and their development often failed to keep pace with that of the generators. But in modern hydraulic power plants of any importance, each piece of apparatus is constructed to suit the particular conditions under which it must operate. This practice insures a superior quality of machinery, reduces the cost of maintenance, and at the same time insures greater regularity in operation; yet it does not wholly solve the problem of "efficiency," for, upon being assembled, the various parts, separately designed, may not be found to work in complete harmony.

Portable Electric Drills.

The Duntley portable electric drills which are illustrated herewith are built in three distinct types, known as the single-

FIG. 1.—SINGLE-MOTOR BREAST DRILL.

motor, two-motor and three-motor drills, respectively. All of these types embody practically the same mechanical features, differing only in the design and general arrangement of the

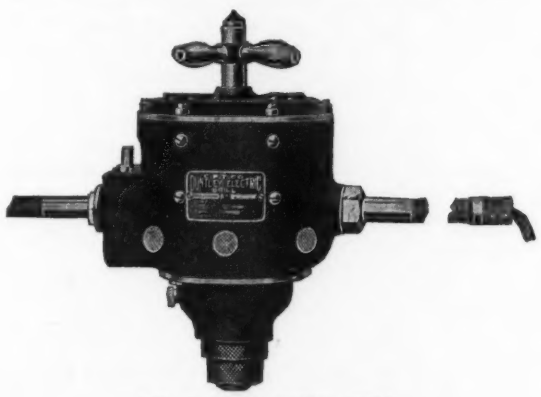


FIG. 2.—TWO-MOTOR DRILL.

electrical parts. The single-motor drill is provided with one armature, and is adapted to all classes of general work for drilling in iron or steel up to 1¼ in. in diameter. Fig. 1 shows a single-motor drill arranged as a breast drill. The motor for

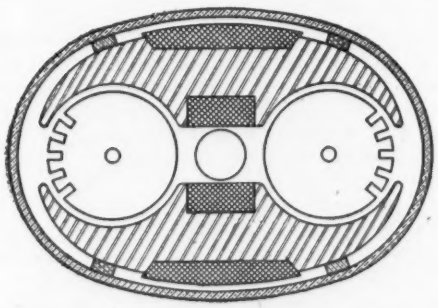


FIG. 3.—CROSS-SECTION THROUGH ARMATURE AND FIELD COILS OF TWO-MOTOR DRILL.

the breast drill and for drills having capacities of ⅜ in. and 1½-in. iron, respectively, are shunt wound, while the motors for larger drills are compound wound.

For drills capable of drilling holes larger than 1¼ in. in diameter, if one armature is used the armature becomes quite large in diameter and the speed must necessarily be reduced to keep down the peripheral velocity. It is for this larger work that the two and three-motor drills become desirable. By the use of two or three small armatures properly geared to the main driving spindle, a greater power can be secured for a given weight on account of the higher speeds that the armatures can be run at with perfect safety. This seeming complicity of parts is made perfectly simple and free from liability to trouble by the special design and construction used on these drills.

Fig. 2 shows the general outside appearance, and Fig. 3 the plan and arrangement of the armatures and field coils in a two-motor drill, while Fig. 4 shows the arrangement of the coils and armatures in a three-motor drill, a sectional view of which

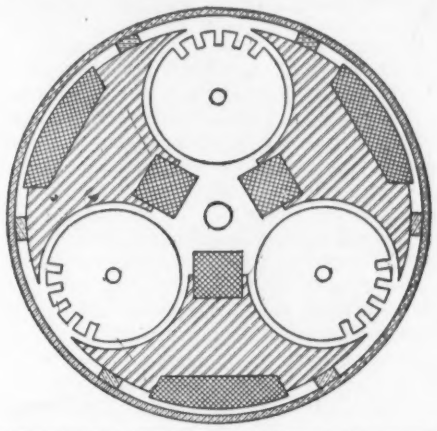


FIG. 4.—CROSS-SECTION THROUGH ARMATURE AND FIELD COILS OF THREE-MOTOR DRILL.

is given in Fig. 5. Since the construction of these drills is somewhat analogous they will be described together. The outer casing is of non-magnetic material. It will be noted that the magnetic flux in each drill passes in series through the armatures, thus insuring the same speed for all three armatures (or two as the case may be).

The motors are provided with both series and shunt field windings. Thus only a low starting current is required and at the same time a fairly close speed regulation is obtained. Fans are placed on the upper or commutator ends of the armature, and air is drawn in here and forced out at the lower end. The

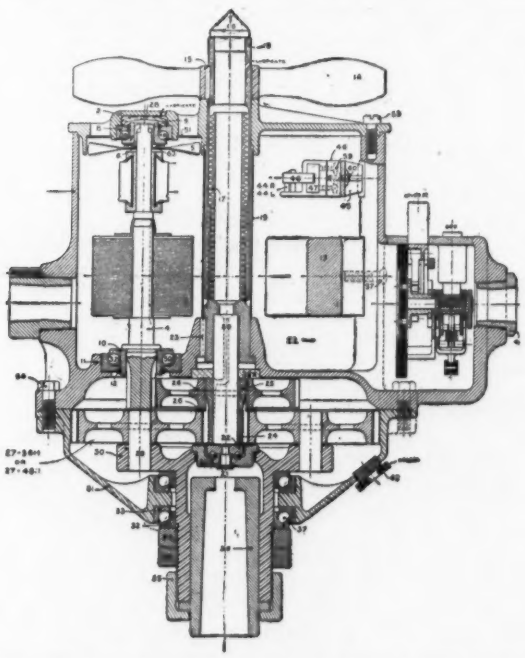


FIG. 5.—SECTIONAL ELEVATION OF THREE-MOTOR DRILL.

electrical construction of the parts, including the switch, is the same in general as for the single-motor drills. The planetary gear arrangement is similar also, involving only such modifications as are made necessary by the increase in the number of driving pinions.

The two and three-motor drills are, as previously stated, adapted to heavy drilling and are used for drilling in iron or steel up to 2¼ in. and for boiler-plate reaming and stay-bolt tapping. It is stated that on large holes they have removed 2¼ cu. in. of cast iron per minute with comparative ease.

These drills are manufactured by the Chicago Pneumatic Tool Company, Chicago, Ill.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.—Taking trade conditions as a whole there was some quietness incident to the midsummer period, but as a rule values have been well maintained with collections quite good. Industry is of very large volume for an ordinarily quiet midsummer period and crop reports are very favorable. Building continues active without apparent check; the iron and steel trades report shorter than usual shutdowns probable, and the likelihood of large surplus supplies of wheat and corn lead to the hope that export trade will show expansion in a short time. An immense volume of business is offering to the railroads, which has resulted in a gain in gross earnings of over 13 per cent for June as compared with the same month a year ago. Prices of staples as a whole show some easing on revisions, due to new crop pressure, but on the whole are steady at close to the high levels of the year. Production of pig iron for the first half of the year amounted to 12,281,258 tons, 10 per cent in excess of the output during the like period in 1905. Steel-making irons are still scarce and steel billets continue in short supply. New orders for steel rails are fair and some heavy business is pending. Structural steel shops are receiving good orders for bridge building material, while many railways are inquiring for track supplies for 1907, and light steel rails are up 50 cents a ton. Western agricultural implement makers have begun earlier than usual to manufacture stock for the season of 1907. Copper is lower. The largest copper consuming interest in Europe in placing a large contract in this market covered requirements for the year in electrolytic at 18½c., f. o. b. at New York. A number of German, British and French copper workers on a large scale have done likewise. In this market there is no visible supply of electrolytic, and there is little lake and casting copper ahead of the demands. This accounts for the firmness of prices. Lake is quoted at 18¾ to 18⅞c.; electrolytic, 18½ to 18⅝c., both sorts for September shipments, and 18½ to 18⅝c. for prime casting copper, thirty days. *Bradstreet's* reports 143 business failures during the week ending July 12, as against 134 in the week previous and 166 in the corresponding week last year.

ALLIS-CHALMERS ORDERS and sales are of notable number and magnitude as follows: Steam engine department: Mobile Electric Company, Mobile, Ala., Reynolds heavy duty cross-compound Corliss engine. Colorado & Utah Construction Company, San Francisco, Cal., Reynolds Girder Corliss engine. A. H. Vilas Company, Chicago, Ill., Reynolds Reliance Corliss engine and 175 kw engine type generator. National Conduit & Cable Company, Hastings-on-Hudson, N. Y., 2 Reynolds heavy duty cross-compound Corliss engines; 2 300 kw engine type generators. Phelps & Sibley, Cuba, N. Y., Reynolds Reliance Corliss engine and 4 kw generators. The Baer Company, Leighton, Pa., Reynolds Reliance Corliss engine and 200 kw direct-current generator. Union Water, Light & Traction Company, Nevada, Mo., Reynolds Reliance Corliss engine, 300 kw generator, 15 kw generator, 60 kw motor generator set and 2 25 hp motors. John S. Owen Lumber Company, Owen, Wis., Reynolds Reliance Corliss engine, 80 kw belted Bullock alternator and two-panel switchboard. Electrical Department: Pittsburg Steel Company, Monessen, Pa., 300 hp motor. H. S. Tanaka & Company, Tokyo, Japan, two 4 kw generators, two 6 kw generators, two 9 kw generators, two 12½ kw generators and two 15 kw generators. Toledo Gas, Electric & Heating Company, Toledo, O., two 300 hp synchronous motors, two 100 hp motors, two 14 kw direct-connected exciters and one 20 hp motor. National Starch Company, Waukegan, Ill., ten 75 hp special vertical induction motors, one 700 kw generator and one 20 kw direct-connected exciter. Glucose Sugar Refining Company, Davenport, Ia., one 800 kw generator, one 20 kw direct-connected exciter, eight 75 hp special induction motors and 57 induction motors. National Cash Register Company, Dayton, O., one 1,000 kw steam turbine and one 1,500 kw generator. Meriden Electric Light Company, Meriden, Conn., one 500 kw steam turbine and one 500 kw generator. Interstate Railways Company, Wilmington, Del., one 500 kw steam turbine generating unit, one 40 kw and one 10-inch x 10-inch engine direct-connected. Gas Engine Department: Illinois Steel Company, Chicago, Ill., four 42-inch x 54-inch horizontal four-cylinder double acting twin tandem gas engines, direct-connected to four 2,000 kw A. C. Bullock generators. Crystal City, Mo., plant, Pittsburg Plate Glass Company, one 100 kw horizontal twin tandem gas engine generator unit. Carnegie Steel Company, Homestead Works, four horizontal twin tandem gas engine blowing engines, 3,000 b.h.p. each, one horizontal twin tandem gas engine generating unit, 2,000 kw. National Tube Company, McKeesport, Pa., one 1,500 kw horizontal twin tandem gas engine generating unit. Trenton Iron Company, Trenton, N. J., one 24-inch x 32-inch horizontal twin tandem gas engine and one 350 kw direct-connected engine type generator. Illinois Steel Co., Bay View Works, Milwaukee, one 500 kw gas engine generating unit.

STEAM TURBINES IN LIGHTING PLANTS.—The Public Service Corporation of New Jersey has recently placed orders with the Westinghouse Machine Company, of East Pittsburg, Pa., for 2 1,000 kw and 1 500 kw Westinghouse-Parsons steam turbines. The first two to be installed in their plant at Cooper's Creek, Camden, N. J., and the latter at Cranford, N. J. The new station at Cooper's Creek will contain three turbines of 1,000 kw capacity, the first one having been ordered some time ago, as an extension to the old Corliss engine equipment. These turbines will operate under 150 pounds steam pressure, 28-inch vacuum and 105 degrees superheat, and will be direct-connected to 1,000 kw Westinghouse enclosed type turbo-generators delivering 2,400 volts to a two-phase 60-cycle distribution system. This plant will burn soft coal under six 500 hp Sterling Consolidated water tube boilers of the Babcock & Wilcox type, and will use Foster superheaters and Williamson condensing system. The Cranford turbine will also deliver 2,400 volts current at a frequency of 60 cycles to a two-phase distribution system. The turbine will operate under a steam pressure of 125-140 pounds and 26-inch vacuum. The Wheeler surface condensing system will be used.

ENLARGING STANLEY PLANT.—Advices from Pittsfield, Mass., state that first vice-president Chesney, of the Stanley Electric Company, has awarded to Whitney Brothers, of North Adams, the contract for the erection of the big factory buildings on lower East Street, which are to be connected with the incandescent arc light works. Although no figures are given out it is understood that the contractors will receive about $100,000. Work is to begin as soon as possible, in order that the structures be completed and made ready for occupancy early in the fall. The new buildings will be the largest owned by the company and will be three stories in height. The main structure is to be 375 by 80 feet and will have an L 146 by 90 feet; the buildings will be of brick, with stone foundations, and of heavy mill construction. As soon as completed employment will be given to at least 400 more hands.

WIRELESS OUTFITS.—Mr. H. Hartley Dodge left New York July 11 on the steam yacht *Wakiva,* accompanied by Prof. J. B. Moore and Prof. Wm. H. Shepard, of Columbia University; H. A. Cushing, N. E. Crosby, Eugene Delano, Jr., Dr. J. N. Cannon and J. H. Thompson on their way to Rio Janeiro. They will attend the Pan-American Congress, after which they will make a short trip up the Amazon River. The De Forest system of wireless telegraphy was installed on the yacht before she left. The Old Dominion Steamship Company has arranged with the Atlantic De Forest Wireless Company for the installation of wireless telegraphy on board its steamship *Monroe.* If the service on this steamer proves satisfactory, the remainder of the Old Dominion fleet will be installed.

REID ELECTRICAL CONSTRUCTION CO.—A petition in bankruptcy was filed June 27 in the United States District Court, St. Louis, against the Reid Electrical Construction Co., by the Pittsburg Lamp, Brass and Glass Co., the Ewing-Merkle Electrical Co., of St. Louis, the J. H. White Manufacturing Co., of Brooklyn, David Shapir, Mayor of Anderson and H. E. Franke, of Milwaukee, Wis. The petitioners allege that the firm committed an act of bankruptcy June 28, 1906, by admitting in writing its inability to pay its debts and its willingness to be adjudged a bankrupt on that ground.

CAMBRIA STEEL WORKS.—The extension to the washery and storage building under construction by the Cambria Steel Company, Johnstown, Pa., is to be heated and ventilated by apparatus furnished by B. F. Sturtevant Company, Boston, Mass. The fan is to be electrically driven with direct-connected motor.

W. S. BARSTOW & COMPANY, 56 Pine Street, New York, are the engineers for the New Jersey Company, Mattawan, N. J., which is making improvements and additions to its plant. The remodeled plant will have double the capacity of the old one. In order to meet the increased shipping requirements, a large dock will be built on Mattawan Creek, and a new power house will provide for electric drive and lighting throughout the plant.

THE CHEMICAL INDUSTRY.—The report of the Bureau of the Census shows that on January 1, 1905, there were 448 chemical manufactories in operation, a decrease of 2.4 per cent over 1900; capital employed, $119,690,193; increase, 34.6; wages paid, $13,253,692; increase, 104.8; salaried officials, clerks, etc., $4,901,523; increase, 67.7; value of products, $92,088,378; increase, 46.9.

NEW CABLE BUILDING.—The contract for the $100,000 electric cable building at the south works of the American Steel & Wire Company, at Worcester, Mass., has been awarded to F. W. Mark, Day Building.

Financial Intelligence.

THE WEEK IN WALL STREET.—The stock market was heavy and irregular throughout the week, liquidation bringing some prices down to the lowest level of the year. Restricted money market conditions created more or less anxiety in speculative circles, and public indifference to the stock market was of a marked character. Bonds are heavy and show an inclination to sag off on very limited investment demands. There were few developments of any special importance which would affect the action of the stock market, and the industrial issues shared the heaviness and irregularity of the general market. Allis-Chalmers fell to the lowest price of the year for that stock—16—and closed at 16¾, a net decline of ¾. Preferred, on the other hand, gained 1 point, closing at 46¾. General Electric also closed at its lowest figure of the year, viz., 160¼, which is a net loss of 3¾ points, but Westinghouse made a gain of 1¾, closing at 152. American Locomotive closed at 86, an advance of ¾-point. Among the tractions, Brooklyn Rapid Transit dropped to the lowest quotation of the year—71—but regained some of the loss and closed at 72½, which is a net loss of 2½ points. Interborough-Metropolitan common closed at 36¼ and preferred at 74, the former being a decline of ¾ and the latter an advance of ½-point. Metropolitan Street Railway declined 1⅝ points, the closing quotation being 103⅜. Western Union dropped ½-point, closing at 91½, and American Telephone & Telegraph 1½, the last quotation being 131¼. Other quotations are: New York & New Jersey Telephone rights 2⅝, American District Telegraph 25, American Telegraph & Cable 90, Electric Storage Battery 86 asked, Havana Electric Railway common 45, preferred 92⅞ asked, Manhattan Elevated 147 and Michigan State Telephone 50. Liquidation was the one feature in the trading on the curb market, and breaks of 2 to 5 points were scored in several issues, notably Chicago Subway and Greene Copper. The closing quotations of July 17 are given in the accompanying table.

NEW YORK*

	July 9	July 17		July 9	July 17
Allis-Chalmers Co.	16¾	16	General Electric	163	162
Allis-Chalmers Co. pfd.	47⅛	42	Hudson River Tel.	...	...
American Dist. Tel.	30	25	Interborough Rap. Tran.	...	35¾
American Locomotive	67	68¾	Mackay Cos.	72½	71¾
American Locomotive pfd.	113	112	Mackay Cos pfd.	72	71¾
American Tel. & Cable	90	90	Marconi Tel.	...	42
American Tel. & Tel.	132	125	Metropolitan St. Ry.	...	...
Brooklyn Rapid Transit	74⅛	73⅛	N. Y. & N. J. Tel.	...	...
Electric Boat	25	25	Western Union Tel	92	91¼
Electric Boat pfd	70	70	Westinghouse com.	150	150
Electric Vehicle	10	10	Westinghouse pfd.	...	...
Electric Vehicle pfd.	15	15			

BOSTON

	July 9	July 17		July 9	July 17
American Tel. & Tel.	131	130¾	Mass. Elec. Ry. pfd	69⅛	69
Cumberland Telephone.	...	...	Mexican Telephone	...	3⅜
Edison Elec. Illum.	240	240	New England Telephone	130¾	129⅛
General Electric	...	...	Western Tel. & Tel.	...	...
Mass. Elec. Ry.	...	19	Western Tel. & Tel pfd.	...	...

PHILADELPHIA

	July 9	July 17		July 9	July 17
American Railways	52	52¼	Phila. Electric	7⅞	7⅞
Elec. Co. of America	11¼	11⅜	Phila. Rapid Trans.	25	29¼
Elec. Storage Battery	68	67⅛	Phila. Traction	99	99
Elec. Storage Battery pfd.	...	..			

CHICAGO

	July 9	July 17		July 9	July 17
Chicago City Ry.	165	160	National Carbon	85	85
Chicago Edison	...	...	National Carbon pfd.	118	118
Chicago Subway	45¾	43	Union Traction	...	...
Chicago Tel. Co.	...	...	Union Traction pfd	...	...
Metropolitan Elev. com.	26	26			

* Asked

DIVIDENDS.—The directors of the Michigan State Telephone Company have declared a regular quarterly dividend of 1½ per cent on the preferred stock, payable August 1 to stock of record July 21. The directors of the Colorado Telephone Company have declared a regular quarterly dividend of 1½ per cent, payable July 15. The regular quarterly of 2 per cent on Chicago Edison is payable August 1. The Minneapolis General Electric Company has declared the regular semi-annual dividends of 3 and 2 per cent respectively on the preferred and common stocks, payable August 1. The directors of the Electric Company of America have declared the regular semi-annual dividend of 3½ per cent. A semi-annual dividend of $3 per share has been declared, payable on the preferred capital stock of the Houston Electric Company, August 1. Directors of the Central District & Printing & Telegraph Company have declared the regular quarterly dividend of 2 per cent payable July 31. The directors of the Automatic Electric Company have declared the regular quarterly dividend of 2 per cent payable August 1. The directors of the Milwaukee Electric Ry. & Light Company have declared the regular quarterly dividend of 1½ per cent on the preferred stock, payable July 31. The regular quarterly dividend of 1¾ per cent has been declared on the preferred stock of the National Steel & Wire Company. A semi-annual dividend of 4 per cent has been declared by the Pittsfield, Mass., Electric Company. Heretofore an annual dividend of 8 per cent was declared in September, but in future two payments will be made, on July 1 and January 1, respectively. The directors of the Montreal Light, Heat & Power Co. have increased the rate of dividend from 4 per cent to 5 per cent yearly. The first quarterly dividend of 1¼ per cent is payable on August 15. Directors of the Electric Bond & Share Co. have declared the regular quarterly dividend of 1¼ per cent on the preferred stock, payable August 1. The directors of the Edison Company, of Boston, have declared the regular quarterly dividend of 2½ per cent, payable August 1. The directors of the American Graphophone Company have declared the regular quarterly dividend of 1¾ per cent on the preferred stock, payable August 15. The directors of the Jacksonville Electric Company have declared the regular semi-annual dividend of $3 on the preferred stock, payable August 1.

DAKOTA TELEPHONE MERGER.—Many of the leading business men of the state are taking a prominent part in the organization of the North Dakota Independent Telephone Company, which will be comprised of practically all of the independent telephone companies of North Dakota. New contracts have been made with the telephone companies in the northern and southern parts of the state so that there are more than 3,000 miles of toll lines controlled by the new company, which has been incorporated with a capital of $3,000,000. The leading spirits in the merger are President Jones and vice-president Weiser of the First National Bank of Fargo, and associated with them are President H. P. Lyon, of the First National Bank of Mandan; President M. B. Cassel, of the First National Bank of Mayville; J. D. Brown, a prominent banker of Hope; A. B. Cox, of Valley City, and E. H. Moulton, president of the Tri-State Telephone Company and the Farmers' Mechanics Bank of Minneapolis. Fargo will be the headquarters of the new organization and within a short time a line will be operating in that city, from which will radiate lines to all parts of the state. The company is financed by North Dakotans, although persons interested in the Tri-State Telephone Company own stock in the new organization. The officers of the new company will be as follows: President, H. P. Lyon, Mandan; vice-presidents, Robert Jones, Fargo; J. D. Brown, Hope; secretary, A. B. Cox, Valley City; treasurer, E. H. Weiser, Fargo; board of directors, Robert Jones, Fargo; E. H. Weiser, Fargo; H. P. Lyon, Mandan; J. D. Brown, Hope; A. B. Cox, Valley City; E. H. Moulton, Minneapolis; M. B. Cassel, Mayville.

UNION ELECTRIC LIGHT & POWER COMPANY, whose first mortgage bonds have been listed on the Stock Exchange, is controlled by the North American Company. It is a consolidation of the old Union Electric Light & Power Company, which was itself a consolidation of three electric light and power companies of St. Louis, with the Missouri-Edison Electric Company, which had acquired the property and franchises of ten lighting and power corporations. The company is capitalized at $10,000,000. Of the company's stock, $3,000,000 is treasury stock, pledged as security for $1,875,000 three-year notes, while an additional $1,115,000 is held in trust for the treasury. Of the remainder, the North American Company holds $5,655,575 and $175,325 is reserved for exchange for the outstanding stock of the Missouri-

Edison Electric Company. The company's bonded debt consists of the $10,000,000 first mortgage bonds, of which $4,115,000 remain in the treasury, and $3,952,000 bonds of underlying companies. The treasury bonds are reserved for the exchange or redemption of the underlying issues. In 1905 the company's earnings over interest charges, taxes and all current deductions, were 5.7 per cent on the $5,885,000 stock standing outside the company's treasury. The company supplies St. Louis with electricity for lighting and power purposes. Its franchises expire in 1940. It has a lighting contract with the city running ten years. Among the directors are John I. Beggs and Charles F. Pfister, of Milwaukee; Adolphus Busch, Breckenridge Jones and Julius S. Walsh, of St. Louis, and George R. Sheldon and C. W. Wetmore, of New York.

LIGHTING AT PORTLAND, ME.—The Portland Electric Light Company with a capital of $1,500,000 paid in, has been organized. The officers are: President, Charles O. Bancroft; directors, Charles O. Bancroft, Franklin C. Payson, Walter G. Davis, Harry Butler, William M. Bradley, George H. Richardson and Alpheus G. Rogers, all of Portland, and C. S. Erswell, of Chicago, and Carl P. Dennett, of Bangor, Me. The corporation is composed of representatives of several of the local banking institutions. The company has bought the Hargraves Woolen mill property at West Buxton and will begin August 1 the construction of a power station for the transmission of electricity for lighting and power purposes in Portland and vicinity. The same company is also to acquire the plants and good will of the Consolidated steam plant and the Portland Electric Lighting & Power Company, operated by water power from Great Falls. The purchase of these companies involves the expenditure of a million of dollars. The new company will not discontinue the plant of the Consolidated Co., but on the contrary extensive improvements will be made on this and the property of the Portland company, while the power house of the latter concern on the Presumpscot River will continue to be operated.

ALLIS-CHALMERS BONDS TO ISSUE.—In spite of objections made by a certain number of stockholders the plan of the directors of the Allis-Chalmers Company to issue $15,000,000 of bonds was carried at the special meeting in Jersey City on July 16. About 80 per cent of the stock was voted in favor of the proposition. F. W. Kelsey, in the interest of the minority stockholders, introduced a resolution to defer action on the bond issue until the annual meeting, with a committee of five, to investigate the plans and report. His resolution was voted down, after Judge Gary had explained the plan of the directors at length and had assured the stockholders that it would be to the best interest of the company to issue the bonds. Of the new bond issue $12,000,000 is offered for subscription by the stockholders at 80. The remaining $3,000,000 is reserved for the present in the company's treasury. A syndicate represented by Shearson, Hammill & Co. were authorized by the stockholders to underwrite such of the new bonds as are not taken by the stockholders. The new funds supplied by the bonds will be used primarily to extend the plants, and to furnish working capital. The company has $11,000,000 of orders on hand, $3,000,000 of which were secured last month. The company's property is insured for $20,000,000.

ST. LOUIS TROLLEYS.—Negotiations for the purchase by the North American Company of the St. Louis & Suburban Railway Company, the only independent traction system left in St. Louis, were discussed at the last meeting of the executive committee of the North American Company. Ever since the purchase by the North American Company last year of the United Railways Company of St. Louis, it has been reported from time to time that the company has been negotiating for the Suburban Company. The control of this road would give the North American Company a monopoly of the street railway business of St. Louis. The St. Louis & Suburban Railway Company is a reorganization of the St. Louis & Western Railway Company and operates about 100 miles of street railway in St. Louis and its suburbs. It has an authorized capital of $7,500,000, of which $4,000,000 has been issued. Its bonded indebtedness and that of its subsidiary companies amounts to $7,500,000.

NEW ENGLAND POWER EXTENSIONS.—The Massachusetts Board of Gas and Electric Light Commissioners gave a hearing last week to President Rogers, of the Beverly Gas & Electric Company, on the petition of the company for the right to issue $200,000 of new capital stock. The present capitalization of the company is $194,000. The money is to be used for various improvements and extensions, including a holder, purifiers and new wharf facilities, coal sheds, new street mains, meters and electric extensions. The Lawrence Gas Company has petitioned the commissioners for authority to issue $400,000 stock to be used in paying outstanding indebtedness and for further improvements. The Haverhill Electric Company has petitioned the commissioners for authority to issue $120,000 capital stock, to be used for new construction to power houses and distributing system.

PORTLAND GENERAL ELECTRIC BONDS.—N. W. Harris & Co. have bought $952,000 first mortgage 5 per cent bonds of the Portland General Electric Company, shortly to be issued by the company for the purchase of the Citizens' Light & Traction Company, Salem, Ore., and another similar property for which negotiations are now under way. The bonds are a part of a $10,000,000 issue, of which $4,952,000 will be outstanding after this issue. The remainder is reserved for future purchases, improvements and extensions under the usual limitations. For the year ending March 31, 1906, the following income account is published:

Gross	$921,940.87
Expenses and taxes	441,434.95
Net	$480,505.92
Interest	200,000.00
Surplus	$280.505.92

NORTHERN OHIO DEAL.—The plan under which the Northern Ohio Traction & Light Company will acquire the properties of the Tucker Anthony & Company syndicate in northeastern Ohio will become operative in about 60 days. The plan includes an exchange of stock. The capital of the Northern Ohio Company will be increased from $7,500,000 to $10,000,000, while the preferred stock of the Canton-Akron line will be transferred for 6 per cent divisional lien mortgage bonds, and the common stock for Northern Ohio stock at par. For the other lines an exchange of stock has been arranged which is attractive as the Northern Ohio has just paid its first dividend of ½ of 1 per cent of the past quarter. This merger will result in a system of 202 miles.

POTOMAC POWER BONDS.—The Potomac Electric Power Company, of Washington, D. C., has issued $1,300,000 5 per cent consolidated bonds, dated June 30, 1906, and maturing July 1, 1936. The proceeds of the bonds will be used to purchase 12½ acres of land and build new power stations. Brown Bros. & Company have bought the issue and offer the bonds at 99 and interest. President McDermott reports the earnings as follows, annual interest charges being $189,000, inclusive of the new issue:

	Gross.	Expenses.	Net.
1904	$749,528.05	$359,401.61	$390,126.44
1905	866,797.08	410,969.16	455,827.92
Five months 1906	422,038.46	209,408.30	212,630.16

BAR HARBOR PLANTS.—The news has been given out at Bangor, Me., of the purchase of the Bar Harbor and Union River Power Company by a syndicate of New York and Philadelphia capitalists, of which John R. Graham of Bangor, is the head. The men behind the deal are the owners and principal stockholders of the Bangor Railway & Electric Company, the Lewiston, Brunswick & Bath Railway and other enterprises in the State.

SALE OF TELEPHONE PROPERTY.—The entire rights of the Interstate Telephone Company of Trenton, N. J., will be sold at auction in the Sheriff's office on August 15. The sale will include all the lines, both telephone and telegraph, telephone exchanges, electric appliances, rights of way, stocks, bonds, securities of other companies, corporate rights, franchises and real and personal property of the company. The sale is a part of the reorganization plan of the company.

BROOKLYN TROLLEY MORTGAGE.—The New York State Board of Railroad Commissioners has granted the application of the Brooklyn City Railroad for leave to issue a refunding mortgage for $6,925,000, the money to be used in taking up underlying bonds of subsidiary companies. The bonds to be issued will bear 4 per cent interest.

INDIANA TROLLEY BONDS.—It is reported in Philadelphia that Drexel & Company have agreed to help float the bonds of the Widener-Elkins Indiana traction merger under the name of the Indianapolis, Columbus & Eastern Traction Company. The capital is placed at $24,000,000, $12,000,000 of which is to be a bond issue.

THE CINCINNATI DEAL.—Attorney Lawrence Maxwell, Jr., has been selected to draw up the lease whereby the Cincinnati Gas & Electric Company will be turned over to the Union Gas & Electric Company under a guarantee of dividends. The city has sanctioned the lease.

GENERAL NEWS.

Construction News.

MONTGOMERY, ALA.—The stockholders of the Citizens' Light, Heat & Power Company have organized a new company under the name of the Citizens' Light & Power Company, and will make extensive improvements. Alexander Rice is president.

ANNISTON, ALA.—The Coosa River Electric Power Company has recently purchased the Gray lands, on the bank of the Coosa River. This property, with the Randolph property acquired previously, gives the company all the land needed for the erection of its dam, power house and tail race.

FORT SMITH, ARK.—W. R. Abbott, president of the Fort Smith Light & Traction Company, has sold his interest in the company to A. S. Huey, of Chicago, Ill.

ALTUS, ARK.—D. A. Allen, of Altus, president of the Southern Power & Development Company, writes that it is proposed to construct a dam across Little Missouri River, near Langley, for light and power purposes. J. D. Crockett, of Denning, is secretary. The dam will develop about 500 hp.

ANAHEIM, CAL.—The Home Telephone Company contemplates extending and improving its system in this city.

SAN FRANCISCO, CAL.—Bids will be received until July 31 by Walter J. Mathews, architect, 960 Broadway, Oakland, on behalf of the Department of Commerce, for furnishing material and constructing a steam power plant, electrical equipment, plumbing, steam-heating plant, hot-water heating plant and electric light wiring, both for buildings and grounds.

REDDING, CAL.—The Siskiyou Electric Power Company has completed the construction of a branch line to Quartz Valley, to supply that section with electricity. The Morrison and Carlock mine has contracted for 150 hp. and other mines have made application for electrical service. The company is also constructing a tap from the main line on Cherry Creek to supply electricity to the Golden Wonder mine.

PASADENA, CAL.—Bids will be received until July 25 by the Mayor and City Council for materials and equipment to be used in the construction of a municipal electric light plant, for which bonds to the amount of $125,000 have been authorized. The work includes power house equipment, reciprocating steam engines, turbines, internal combustion engines, boilers, electrical equipment, generator, switchboards, street lighting equipment, poles, transformers, copper and iron wire, etc. Heman Dyer is city clerk.

NAPA, CAL.—The San Francisco, Vallejo & Napa Valley Railroad Company, which recently filed articles of incorporation here, will operate an electric railway from San Francisco to Vallejo by ferry, thence by cars to Napa, through Napa to St. Helena and Calistoga, and will also have spurs connecting with other railroads in Lake and Sonoma Counties. The length of the main line will be 72 miles. The capital stock of the company is $1,500,000, and the directors are as follows: W. F. Botsford, of Los Angeles; Z. T. Hatch, of Oakland; L. J. Perry and J. T. York, of Napa; C. N. Hatch, of Vallejo.

REDDING, CAL.—The Northern California Power Company is building a new substation at the Mammoth mine. Heretofore this mine has been supplied with electricity from the Kennet sub-station. The company will also build a sub-station at the Balakala smelter, and extend its line to the new saw mill, about a mile distant. A large sub-station is being buit at Tehama to connect the old line with the new. A new 1,500-hp transformer is being installed in the sub-station at Hamilton City. All surveys have been made and the construction has commenced on the connecting line between Volta and Kilarc power plants.

TELLURIDE, COL.—The Telluride Power Company has awarded to the Westinghouse Electric & Manufacturing Company, of Pittsburg, Pa., the contract for the additions to its power transmission plant.

FORT COLLINS, COL.—The City Council has passed an ordinance granting a franchise to the Denver & Interurban Railroad Company to construct and operate a street railway system in Fort Collins. The officers of the company are as follows: A. D. Parker, president; T. S. McMurray, vice-president; H. W. Cowan, chief engineer.

DANIELSON, CONN.—Plans and estimates are being made by the People's Light & Power Company for extensive alterations and additions to its power house and plant.

HARTFORD, CONN.—A. C. Dunham, president Hartford Electric Light Company, has petitioned the Board of Street Commissioners for permission to install conduits for placing wires underground in several streets. It is stated that the company will expend about $40,000 this year for improvements.

WASHINGTON, D. C.—Bids will be received until July 21 by the Commissioners of the District of Columbia for furnishing underground signal and telephone cables for the electrical department of the District of Columbia. Henry B. F. Macfarland is commissioner.

WASHINGTON, D. C.—Bids will be received at the Bureau of Supplies and Accounts, Navy Department, Washington, until July 31, for furnishing at the Navy Yards at Portsmouth, N. H.; Boston, Mass.; New York, N. Y.; League Island, Pa.; Washington, D. C., and Norfolk, Va., naval supplies as follows: Schedule 41—Arc lamp poles, incandescent lamps, carbons, carbon holders, etc., conduit, electrical supplies, etc. Schedule 42—Electric smoothing irons, cable iron, boiler tubes, etc. Schedule 44—Drills, emery wheels, carborundum wheels, sheet copper, sheet zinc, steel plates, black and galvanized steel shapes, brass and copper pipe, pipe fittings, valves, etc. Schedule 45—Condenser tubes, etc. Also on same date for furnishing at the Navy Yards at Charleston, S. C.; Key West, Fla., and Pensacola, Fla., electrical supplies, etc. (Schedule 48); also until August 7, for furnishing at the Navy Yards at Mare Island, Cal., and Puget Sound, Wash., motors and grinders (Schedule 38). Applications for proposals should designate the schedule desired by number. H. T. B. Harris, Paymaster General, U. S. N.

LUMPKIN, GA.—The citizens have voted to issue $15,000 bonds for electric lights, and a school.

ROCKMART, GA.—The machinery has arrived for the new municipal electric light plant. The work on the power house is being pushed as rapidly as possible, and it is hoped to have the plant in operation by August 1.

MINER, ILL.—The Miner Mutual Telephone Company has increased its capital stock from $15,000 to $25,000.

MASON CITY, ILL.—This city has issued bonds to the amount of $10,444 for the erection of a municipal electric lighting plant.

ROCKFORD, ILL.—The Central Heat & Power Company has recently purchased and will soon install a large engine and dynamo which will double the lighting capacity of the plant.

CHICAGO, ILL.—The Drainage Board will receive bids on September 12 for constructing a transformer plant for water power at Western Avenue and the channel. Robert R. McCormick is president.

SPRINGFIELD, ILL.—A certificate of consolidation has been filed by the Springfield Electric Light & Power Company and the Springfield Light, Heat & Power Company, under the name of the Springfield Light, Heat & Power Company. The capital stock of the consolidated company is $1,500,000.

GRAMMER, IND.—The Citizens' Telephone Company will rebuild its plant in this city and install a new switchboard.

COLUMBUS, IND.—The Citizens' Telephone Company, of this city, which owns the telephone system in Elizabethtown, is making arrangements to rebuild the plant there in the near future.

COLUMBUS, IND.—The City Council has granted a fifty-year franchise to the Columbus Street Car & Light Company, to operate an electric railway and do commercial lighting in the city of Columbus.

NEWCASTLE, IND.—The directors of the Indianapolis, Newcastle & Toledo Electric Railway Company has purchased a site upon which the power house and car shops will be built. The plant will cost $300,000. The officers of the company are: D. M. Parry, president; Charles S. Hernly, vice-president; W. E. Stevenson, secretary, and Eli Marrin, treasurer.

ANDREWS, IND.—An electric supply company has asked for a receiver for the Andrews Light & Water Company, a corporation organized early this year, to install a plant to furnish light and water to the town of Andrews. A plant to furnish street and commercial lighting was installed, and the company is promoting an electric railway between Monon and Andrews. W. E. Nichols is secretary, and associated with him are a number of Indianapolis capitalists.

MARSHALLTOWN, IA.—The Retail Merchants' Association, of this city, voted at a recent meeting to enter into a contract with Hamilton Browne, of Chicago, Ill., to build an interurban road from Marshalltown to Ferguson.

CHARLES CITY, IA.—The Charles City Water Power Company has commenced work on the construction of a concrete dam to replace the old one. The company will eventually establish a large electric power plant. E. S. Marrenner is president.

DES MOINES, IA.—The Interurban Railway Company has filed an amendment to its articles of incorporation with the Secretary of State, increasing the capital stock from $1,050,000 to $1,200,000. The additional increase is made necessary by the new line to Woodward, the extension from Woodward Junction to Perry, and the proposed line from Des Moines to Carlisle.

BOONE, IA.—The Fort Dodge, Des Moines & Southern Railway Company, acting for the Newton & Northwestern, has filed with the County Recorder a trust deed to the Old Colony Trust Company, of Boston, Mass., for $2,150,000. The proceeds will be used for the construction of the electric interurban line between Fort Dodge and Des Moines. The Northwestern Construction Company has transferred to the Fort Dodge, Des Moines & Southern Railway Company all property of the Fort Dodge electric line, the Ames College Railway and the right of way secured for the completion of the system.

TOPEKA, KAN.—The City Council on July 9 granted to the Topeka Electrical Company a franchise for 30 years. The probable cost of the proposed plant is $125,000. C. R. Maunsell is the chief promoter.

PADUCAH, KY.—The Home Telephone Company contemplates an expenditure of $175,000 in improvements to its system in this city.

EMINENCE, KY.—The electric light plant at this place was sold at public auction on July 2, under order of the Circuit Court, to T. D. Cole for $4,000.

COVINGTON, KY.—Owen Ford, 710 Security Building, St. Louis, Mo., is consulting engineer for the proposed municipal electric light plant, which will cost about $106,000. John J. Craig is city clerk.

LEXINGTON, KY.—By amended articles of incorporation of the Central Kentucky Traction Company, the company is given the right to construct 194 miles of traction lines from Lexington, Frankfort and Nicholasville, to county seats in Central Kentucky.

LOUISVILLE, KY.—The Board of Public Works will, on August 17, sell a franchise or privilege of stringing wires for the sale of electricity along the streets and public places of the city, and constructing necessary conduits and manholes, and erecting necessary poles, for the installation of such wires.

BANGOR, ME.—Announcement has been made of the purchase of the Bar Harbor & Union River Power Company by a syndicate of New York and Philadelphia capitalists, of which John R. Graham, of this city, is the head. The men behind the deal are the owners and principal stockholders of the Bangor Railway & Electric Company, the Lewiston, Brunswick & Bath Railway. The rights owned by the Bar Harbor & Union River Power Company are capable of developing 8,500 hp. on the Union River, near Ellsworth. The amount of capital involved in the transfer is said to be about $700,000.

ANNAPOLIS, MD.—Mayor Douw in his annual report to Council has recommended a municipal lighting plant.

HYATTSVILLE, MD.—Bids will be received by Joseph R. Owens, Mayor, until July 28, for the construction of an electric light plant and the line work for series incandescent and arc lighting, power plant and building revision. Alternate proposals on steam, producer gas and oil engine equipment will be received. C. L. Reeder, 919-921 Equitable Bldg., Baltimore, is the engineer.

AMESBURY, MASS.—The Amesbury Electric Light & Power Company is installing meters, and hereafter all electricity used for lighting will be metered.

ADAMS, MASS.—The Renfrew Manufacturing Company has recently installed a dynamo in connection with the water wheel and will operate its mill by electricty.

SPRINGFIELD, MASS.—The Commissioners are considering the installation of an electrical equipment to operate the pumps at the new Bear Hole water works pumping station.

LAWRENCE, MASS.—The Lawrence Gas Company has petitioned the Board of Gas and Electric Light Commissioners for authority to issue $400,000 stock to be used in paying outstanding indebtedness and for further improvements.

HAVERHILL, MASS.—The Haverhill Electric Company has made application to the Board of Gas and Electric Light Commissioners for authority to issue $120,000 capital stock, to be used for construction of power houses and distributing system.

BEVERLY, MASS.—The Beverly Gas & Electric Company has petitioned the Board of Gas and Electric Light Commissioners for permission to issue $200,000 of new capital stock. The money is to be used for various improvements and extensions to its system.

LEOMINSTER, MASS.—The Leominister Electric Light & Power Company has contracted with the Leominster Button Company to furnish a 20-hp. motor for operating its works by electricity, and will also supply Spill Brothers with a 10-hp. motor for use in their shops.

ARLINGTON, MASS.—A committee has been appointed to investigate the matter of municipal electric lighting. This committee desires to submit to the town meeting in November a report making a recommendation for an appropriation sufficient to cover a specific bid for making a thorough investigation and reporting thereon, and invites electrical engineers to submit to the present committee an outline, representing an idea of the scope and character of the investigation, and a report and bid for performance of this work. Any further information can be obtained from the committee. Fred. A. Bisbee is chairman.

TRAVERSE CITY, MICH.—The Queen City Electric Light & Power Company has been granted a thirty-year franchise by the City Council.

LAINGSBURG, MICH.—The Village Council has granted a 30-year franchise to Joseph Thick, of Detroit, for operating an electric railway through the streets in this village.

STANDISH, MICH.—The Rifle River Improvement Company has been granted a franchise by the Board of Supervisors to build a dam along Rifle River to Bay City, Saginaw and other points.

KALAMAZOO, MICH.—The franchise applied for by William V. Jacobs, of Chicago, and James T. Upjohn, of Kalamazoo, trustees of the Kalamazoo, Gull Lake & Northern Traction Company for an entrance to the city, has been granted by the City Council.

STANDISH, MICH.—The Board of Supervisors has granted the H. M. Loud Company a permit to lease and purchase property along Au Sable River, and branches from Au Sable and Oscoda, for the purpose of furnishing these towns and others along Lake Huron shore with electricity.

GRAND RAPIDS, MICH.—The Grand Rapids Edison Company is contemplating extensive additions to its underground cable system, through which many of its overhead wires will be placed underground; it is also preparing to remodel the old Lowell water and light plant on Flat River.

STANDISH, MICH.—The Board of Supervisors of Midland County has granted Frank B. Wixom and others of Detroit permission to dam the Tittabawassee at Edonton and other points for developing electricity for electric lighting and other purposes. The plant is to be completed by December 1, 1908, and will cost from $800,000 to $1,000,000.

BRAINARD, MINN.—Articles of incorporation have been filed for the Brainard Hydro-Electric Power Company, with a capital stock of $200,000, by Judd Wright and others.

McCOMB, MISS.—The City Council has ordered an election to be held on August 4 to vote on the question of issuing bonds for a municipal electric lighting plant.

NATCHEZ, MISS.—The Board of Mayor and Aldermen propose to submit a charter amendment to the Governor authorizing the city to issue $100,000 bonds for an electric light plant.

BROOKHAVEN, MISS.—Bids will be received by the Mayor and Board of Aldermen until July 30 for new machinery for the municipal light and water plant. The estimated cost of the plant is $30,000.

KANSAS CITY, MO.—Bids will be received until July 31 by the Board Public Works for furnishing and installing three 200-horse-power water-tube boilers, a 350-horse-power engine direct connected to a 260-kw. generator and two electric passenger elevators. Everett Elliott is secretary.

RED LODGE, MONT.—The Bear Creek Coal Company has recently installed a large electric power plant for operating its mines with electricity. The Montana Coal & Iron Company, of which Elijah Smith, of Boston, Mass., is president, is contemplating the installation of an electric power plant in connection with the development of what is known as the Elijah properties, consisting of 3,000 acres of coal land. George T. Lamport, manager of the company, states that the orders for the machinery will be placed within a few weeks.

OMAHA, NEB.—The citizens have voted to issue $7,000 bonds for an electric light plant.

SCRIBNER, NEB.—The citizens have voted to issue $20,000 bonds for water works and an electric light plant.

TECUMSEH, NEB.—The Johnson County Home Telephone Company has increased its capital stock from $50,000 to $100,000.

OXFORD, NEB.—Thos. O. Norman, city clerk, writes that it is proposed to issue $3,700 bonds for an electric light plant, and $15,000 for water works.

FREMONT, NEB.—S. F. Stiles, City Clerk, writes that an election will be held on August 1 to vote on issuing $80,000 bonds for the construction of an electric light plant. J. W. Andrews is engineer.

HOLDREDGE, NEB.—W. F. Dobbins, of Bertrand, has sold the Holdredge electric plant to M. D. Eames, of Lincoln; E. A. Eames, of Buffalo, N. Y., and L. J. Schwingel, of Danville, N. Y. The new owners will rebuild the entire plant.

BROKEN BOW, NEB.—At a recent meeting of the City Council an ordinance was passed to submit to a vote of the people the proposition to issue bonds in the sum of $15,000 for the purpose of installing an electric light plant for the city.

BEATRICE, NEB.—The Beatrice Electric Company is making extensive improvements and additions to its plant in this city. New generators and switchboards have been received here and a new 365-hp. engine is on the way to be installed in the plant. The improvements will cost about $7,000.

CARSON CITY, NEV.—It is reported that the Truckee River General Electric Company plans to build a hydro-electric station on the Carson River, with which to supply power and lighting to the neighboring ranches. The company is to install a large number of electrically-driven pumps throughout the valley to be used for irrigating arid lands.

MANCHESTER, N. H.—The Manchester Traction, Light & Power Company has awarded the contract for the construction of its new sub-station to James H. Mendell & Company. This station will furnish the power for the line, which is to run from Nashua to Manchester. The new station will be located in Litchfield.

ORANGE, N. J.—Later reports state that no bids will be received at the August meeting of the Council, the Mayor having failed to approve the resolution. There is some talk now of a municipal electric light plant.

NEWARK, N. J.—Runyan & Cary, have submitted to the special committee on municipal lighting, a report on the installation of an independent electric lighting plant in the new municipal building, which they estimate would cost $27,037.

FREDONIA, N. Y.—The citizens have voted to issue $12,000 bonds for extensions to the electric light plant.

LOCKPORT, N. Y.—The International Transmission & Power Company has made application to the Common Council for a franchise to sell electricity in this city.

CALEDONIA, N. Y.—The Niagara, Lockport & Ontario Power Company has purchased a site here, on which it is proposed to construct a transformer station to cost about $50,000.

NEW YORK, N. Y.—Bids will be received by J. A. Bensel, Commissioner of Docks, until July 23, for furnishing and delivering electrical generating sets, as per contract 1011, Borough of Manhattan.

HORNELL, N. Y.—The New York and Pennsylvania Telephone & Telegraph Company has applied to the Common Council for permission to place its wires underground in this city. The cost of the work will be about $200,000.

BROOKLYN, N. Y.—Bids will be received until July 23 by the Board of Education, New York City, for installing electric light wiring, fixtures, etc., in school 17, school 22, Borough of Brooklyn; also school 86, Maspeth, Borough of Queens.

NEW YORK, N. Y.—Bids will be received until July 26 by Louis F. Haffen, President Bronx Borough, for constructing a generating plant and electrical work for Bronx Borough Court House, at Brook Avenue and East 161st St.

SODUS, N. Y.—The Sodus Gas & Electric Light Company has petitioned the State Commissioners on Gas and Electricity for permission to increase its capital from $15,000 to $20,000 for establishing a street lighting system in Sodus, and extending its lines to Williamson.

LEROY, N. Y.—The Leroy Hydraulic Electric Company has secured the contract for furnishing 500 hp. to the Leroy Cotton Mills Company, competing in price with that offered by the outside company. The Alderman recently granted the Genesee County Electric Power & Gas Company permission to bring its lines into the village, for the purpose of furnishing electricity to the Leroy Cotton Mills Company; this will not be done now as the company has contracted with the local company to supply electricity for operating its plant. The Leroy Hydraulic Electric Company will increase its plant by an additional dynamo and will probably install another engine.

NEWTON, N. C.—Mayor J. P. Young, W. H. Gaither and associates are behind the movement to construct an electric light and water plant in this city.

WINSTON, N. C.—A franchise has been granted to the Winston-Salem Southbound Railway, a steam road, to build an electric railway in the city.

BLUITT FALLS, N. C.—Hugh MacRae & Company, of Wilmington, N. C., propose developing Bluitt Falls for electrical purposes. Lockwood, Greene & Company, of Boston, Mass., are the engineers.

STATESVILLE, N. C.—The Southern Bell Telephone Company has purchased a site for a new telephone exchange building, and will make many improvements in this city to its system. The company contemplates an expenditure of about $30,000.

BUFORD, N. D.—Bids will be received until September 10 by the U. S. Reclamation Service at Williston, N. D., for the installation of three transformers of 300-kw. capacity and eight motor-driven pumping units of capacities of 16 and 30 cubic feet per second under heads of 50 and 33 feet respectively, with necessary electrical apparatus and water pipes, in pumping station near Buford.

ST. CLAIRSVILLE, OHIO.—A franchise has been granted to the Belmont Electric Railway Company for its line in this place.

BRUNSWICK, OHIO.—The Brunswick Independent Telephone Company has increased its capital stock from $5,000 to $20,000.

ELYRIA, OHIO.—The Elyria Traction Company has applied for a franchise to operate an electric railway on a number of streets in the city.

LAKEWOOD, OHIO.—At an election held July 5 the proposition for issuing $25,000 bonds for additions to the municipal lighting plant was defeated.

CHILLICOTHE, OHIO.—The City Council has advertised for bids for furnishing 213 arc lamps of 1,200 cp each for lighting the city. The present contract expired July 1.

CINCINNATI, OHIO.—Dittoe & Wissnall, local engineers, are preparing plans for a large power building to be erected by C. Pew in Cincinnati. A large power plant will be installed in the building.

YOUNGSTOWN, OHIO.—The Youngstown Consolidated Gas & Electric Company, which is a part of the Mahoning & Shenango Valley Traction & Light Company, is preparing to erect a large addition to its power station.

TOLEDO, OHIO.—The Ottawa Beach & Southern Railway Company has awarded the contract for a combination passenger station and substation, to be erected at its Ottawa Beach terminal. Power for the substation will be furnished by the Toledo Railways & Light Company.

DESHLER, OHIO.—The Village Council has contracted with Sumner Cottingham for seven more arc lamps in addition to the fifteen now in use. Mr. Cottingham was recently granted a franchise for a lighting system, and plans to have his new plant in operation within thirty days.

YOUNGSTOWN, OHIO.—The Youngstown & Southern Railway Company, which has its lines in operation from Youngstown to Columbiana as a steam road, is placing contracts for the electrification of this portion of the line. The line will be equipped with overhead trolley and will be extended to Leetonia.

SPRINGFIELD, OHIO.—The Consolidated Public Utilities Corporation of New Jersey has obtained an option on the plant and business of the People's Light, Heat & Power Company, of Springfield, and the question of a sale will be decided at a meeting of stockholders on July 17. The company has a capitalization of $2,000,000.

CANTON, OHIO.—The electric lighting and steam heating plant of the Merchants' Heat, Light & Power Company has been sold to the people who own the Stark electric railway. The Stark Electric Company is preparing to absorb other lighting plants in towns on its system and it has negotiations on for the purchase of the Salem Lighting Company, of Salem, and the Alliance Gas & Electric Company, Alliance, Ohio.

TORONTO, OHIO.—The plant and business of the Toronto Electric Light & Power Company has passed into the hands of the Ely syndicate. Van Horn Ely has been elected president of the company; Edwin McDonald, secretary-treasurer; J. C. Rothery, general manager, and L. Richards, chief engineer. President Ely states that the company is planning to enlarge its plant and that it will build several lines to the village of Empire, and to other nearby villages to suppy them with electricity for lighting. A day service will be instituted in Toronto.

COLUMBUS, OHIO.—City Solicitor Marshall has recommended to the City Council that the city enlarge the municipal lighting plant, utilizing the Jeffrey dam north of the city for producing electricity, and that the municipal plant engage in the sale of electricity for commercial purposes. He recommended the Council to re-enact the five-cent per kw. ordinance as a maximum charge for electricity furnished to the public, pending the final disposition of the suit now in the United States Court. He also recommended that the question of issuing bonds for the purchase of additional equipment be submitted to the Council at the election in November.

PORTLAND, ORE.—About $400,000 will be expended in enlarging and improving the plant and system of the Pacific States Telephone Company in this city.

PORTLAND, ORE.—Plans are now being made by the Portland General Electric Company for placing its electric wires and cables underground in the business section of the city in the near future. It is estimated that the cost will not be less than $500,000. H. W. Goode is president.

EUGENE, ORE.—Emery C. Dye, of Oregon City, said to represent the Willamette Valley Traction Company, has fixed on five different power sites on the McKenzie River. It is said that 80,000 hp can be developed at all of these sites combined. The water power will be used for the manufacture of electricity for the operation of an electric railway which is intended to be built up the McKenzie to the Blue River mines.

BOYERSTOWN, PA.—Arrowsmith and Fichthorn, of Reading, have petitioned the Council for a franchise to construct and operate an electric light plant in Boyerstown.

BERWICK, PA.—The Berwick & Nanticoke Street Railway Company has secured the right of way for the construction of a line along the river road from the Berwick town limits to Shickshinny Borough.

MIDDLETOWN, PA.—The Borough Council has granted the York Haven Water & Power Company the right to furnish Middletown with electricity for light and power purposes. E. F. Baker is general manager.

PHOENIXVILLE, PA.—The Audubon Street Railway Company is negotiating for the Montgomery & Chester Electric Railway between Phoenixville and Spring City. The line is to be extended from Phoenixville to Ardmore.

PITTSBURG, PA.—Arrangements have been perfected for the consolidation of the various traction lines entering Meadville, under the charter of the Meadville Traction Company, with an increase in the capital of the company from $500,000 to $1,250,000.

READING, PA.—Dr. Walter A. Rigg has purchased the Shanaman mill property, in Cumru township for a site for a large power plant for the Metropolitan Electric Company. The new plant when completed will have a capacity of 10,000 hp and will cost about $1,000,000. The old plant on South Seventh Street will be used as a distributing plant.

NINETY SIX, S. C.—Dr. W. H. Holland, of Ninety Six, is engineer in charge of the proposed water works and electric light plant.

CAMDEN, S. C.—The electric light plant at this place, owned by Frank K. Bull, of Racine, Wis., was recently destroyed by fire. The plant will be rebuilt.

HARRIMAN, TENN.—The Board of Water and Light Commissioners of Harriman has awarded the contract for the entire equipment for arc lamps for the city to the Southern Electrical Company, of Nashville.

CHATTANOOGA, TENN.—Sam W. Divine, a local promotor of street railways, states that he has secured privileges from the government to build a car line into Chickamauga Park. His plans, in combination with those of Chas. E. Jones, mean an interurban railway system from Atlanta to Nashville, through Chattanooga, operated by water power from the power plant newly built at the "suck" in the Tennessee River. Mr. Devine now has a petition before the City Council asking for franchises for a line entering the city and which it is proposed to run to Chickamauga Park, Ringgold, Dalton and other Georgia points.

FORT WORTH, TEX.—The Consumers' Light & Heating Company has filed amendments to its charter increasing its capital stock from $100,000 to $200,000.

SALT LAKE CITY, UTAH.—The Rocky Mountain Bell Telephone Company is planning improvements to its system, which will involve an expenditure of $385,000.

SALT LAKE CITY, UTAH.—At a citizens' meeting held recently to consider the question of street lighting, a motion was carried that the city should own and operate an electric light plant; also that the Council make temporary arrangements for lighting the streets pending the erection of a municipal plant.

LYNCHBURG, VA.—The Board of Supervisors of Campbell County has granted the Lynchburg Traction Company the right to extend its College Hill line to the Fair Grounds over the Salem Turnpike.

PORTSMOUTH, VA.—The Council has authorized the Lighting Committee to investigate and report on the question of constructing a municipal light plant.

NORFOLK, VA.—The Schofield Construction Company has been awarded the contract for the construction of the power house for the Norfolk & Portsmouth Traction Company for $190,000.

OLYMPIA, WASH.—The Council has granted F. M. Kincaid, a light, heat and power franchise.

SPOKANE, WASH.—Sanderson & Porter, of Boston, Mass., have secured the contract for constructing a power plant for the J. P. Graves Inland Empire Railway Company, at Nine Mile Bridge.

VANCOUVER BARRACKS, WASH.—Bids will be received until July 25 by the constructing quartermaster, at Vancouver Barracks, for wiring the quartermaster's storehouse and for one arc lamp, including service connections.

NORTH YAKIMA, WASH.—A company of Yakima business men, forming a corporation under the title of the Inter-Valley Traction Company, has applied to the City Council for a franchise for a street railway for a term of fifty years.

SPOKANE, WASH.—The Hazlewood Company has planned a large irrigation scheme for pumping water by electricity to irrigate 4,000 acres of land. The enterprise will be incorporated under the name of the Hazlewood Farm. The pumping plant, reservoir and irrigation system will cost between $150,000 and $200,000.

WEST SEATTLE, WASH.—Application has been made by the Seattle Electric Company to the Board of County Commissioners for a franchise for an electric railway, to be known as the Fauntleroy Park line, which will run from Pioneer Place to the south line of Fauntleroy Park and terminate a few hundred feet from the Sound.

WALLA WALLA, WASH.—The large power plant of the Northwestern Gas & Electric Company, on the Walla Walla River, which was put out of commission by the flood of May 30, has been repaired and the streets are now lighted for the first time since the flood. The company is preparing to protect the intake with a concrete wing dam. A retaining wall is also to be built.

KINGWOOD, W. VA.—The municipal electric plant was destroyed by fire, and the citizens will be asked to vote on issuing bonds to construct a new plant.

FAIRMONT, W. VA.—The Marion Railroad Company has been organized for the purpose of constructing an electric railway between Fairmont and Fairview, a distance of 12 miles. The following officers were elected: President, T. W. Fleming, Fairmont; vice-president, J. Y. Hamilton, Fairview; secretary-treasurer, Allison S. Fleming, Fairmont.

SUPERIOR, WIS.—The construction of an exchange building and other extensive improvements are contemplated by the Douglass County Telephone Company during the next year.

MARSHFIELD, WIS.—M. G. Fleckenstein, City Clerk, writes that the citizens voted July 14 to issue $35,000 bonds for improvements to the water works and electric light plant.

KENOSHA, WIS.—The Milwaukee Engineering Company, Hathaway Building, Milwaukee, is preparing estimates for a municipal electric light plant for Kenosha, and the citizens will be called upon to vote on issuing bonds for the same. The probable cost is placed at $45,000.

NEENAH, WIS.—Alonzo Burt, president, and J. M. Cottrill, general manager of the Wisconsin Telephone Company, have been in the city inspecting sites for the new telephone exchange for the twin cities, and completing arrangements for laying the wires underground.

HAILEYBURG, ONT.—The Provincial Government has granted permission to this town to develop the water power at Hound Chute, on Montreal River, for electrical purposes. An election will probably soon be held to vote on issuing bonds for an electric light plant. Plans have been completed for both water works and electric light plant.

HAMILTON, ONT.—Tenders will be received on or before Friday, July 27, by the Hamilton, Waterloo & Guelph Railway Company, for the construction of an electric railway between Hamilton and Galt, and Hamilton and Guelph, a total length of nearly 60 miles. Plans and specifications may be seen at the office of Thomas E. Hillman, C. E., Hamilton Provident & Loan Building, Hamilton, Can., to whom all tenders must be addressed.

MAYAGUEZ, PORTO RICO.—Thomas C. Vera has recently constructed an electric light plant at Corcica Sugar central, at Rincon, owned by Domingo Raffucci. Mr. Vera is contemplating the construction of a large electric lighting plant at Haiti.

SASKATOON, SASK.—Bids will be received until August 14 by Adam Turner, secretary and treasurer, for the construction and materials for an electric light and water works plants. Willis Chapman, of 103 Bay Street, Toronto, Ont., is chief engineer.

Company Elections.

SAVANNAH, GA.—At the annual meeting of the Georgia Telephone & Telegraph Company, held recently, the following officers were elected: W. A. Bisbee, president; J. H. Estill, vice-president; W. V. Davis, secretary; C. S. Kenyon, treasurer. A semi-annual dividend of 2 per cent, payable July 25, was declared. The company contemplates an expenditure of a large sum of money for additions and improvements to its system during the coming year.

PENN YAN, N. Y.—At the annual meeting of the Crosby & Barrington Telephone Company the following officers were elected: Charles E. Guile, president; Howard S. Fullager, vice-president; Herbert C. Overshire, secretary and treasurer.

EAST HAMPTON, N. Y.—At the annual meeting of the East Hampton Electric Light Company, held recently, the following officers were chosen: Henry A. James, president; George E. Munroe, vice-president; Joseph S. Osborne, secretary and treasurer.

BUFFALO, N. Y.—At the annual meeting of the Cataract Power & Conduit Company, held recently, the following directors were chosen: Edward D. Adams, John Jacob Astor, D. O. Mills, DeLancey Rankine, Francis Lynde Stetson, Edward A. Wickes, Charles R. Huntley, Daniel O'Day and George Urban, Jr.

MECHANICSVILLE, N. Y.—At the annual meeting of the Half-moon Light, Heat & Power Company held recently the following directors were elected: John C. Duncan, Edward H. Strang, Herbert O. Bailey, William L. Howland, Adelbert J. Harvey, Stephen Lee, William R. Palmer, Dr. George Hudson, Stillwater; G. F. Best, Round Lake; William C. Tallmadge and John W. Gibson. The directors elected the following officers: John C. Duncan, president; Edward H. Strang, vice-president; Herbert O. Bailey, secretary; William L. Howland, treasurer.

RUTLAND, VT.—At the annual meeting of the Rutland Railway, Light & Power Company, held July 8, the following named directors were elected: Tracy Rogers, Binghamton, N. Y.; Leo H. Wise and LeRoy W. Baldwin, of New York, N. Y.; Charles H. West and George T. Chaffee, of Rutland, Vt. Tracy Rogers was chosen president, Leo H. Wise, vice-president, and Charles H. West, secretary and treasurer.

New Incorporations.

JASPER, ALA.—The Home Telephone Company has filed a certificate of incorporation with a capital stock of $4,000. The incorporators are: N. J. Odom, Gyles W. Jones, J. W. Simpson, E. M. Cranford, W. N. Jones and John A. Coldman.

ANNISTON, ALA.—The Asbury Electric Company has been incorporated with a capital of $10,000, to furnish electric power from a plant to be established on Coosa River, near Ten Island Shoals. The incorporators are Capt. W. F. Johnston, Judge D. C. Blackwell, Bridgham Curtis, and others.

ST. JOHNS, ARIZ.—The Arizona Electric Telephone Company has been formed with a capital stock of $100,000. F. W. Nelson is president and Benjamin Schuster, vice-president.

DOVER, DEL.—Articles of incorporation have been filed for the People's Home Telephone Company, with a capital stock of $300,000. The incorporators are Charles P. Abbey, of Chicago, and others.

OROFINO, IDA.—The Farmers' Mutual Telephone Company has been organized by Fred Deiterle, Andrew Smith and Fred W. Powell, for the purpose of constructing a telephone line from this place to Peck and to Gilbert.

SPRINGFIELD, ILL.—The DeKalb, Sycamore & Interurban Traction Company has been incorporated. The capital stock is nominally $100,000.

MAQUOIN, ILL.—Articles of incorporation have been filed by the Maquoin & Southwestern Telephone Company, with a capital stock of $2,500. The incorporators are Asa Rambo and others.

WINDSOR, ILL.—Articles of incorporation have been filed by the Windsor & Richland Townships Mutual Telephone Company, with a capital stock of $2,400. The incorporators are S. Duncan, A. E. Walker and W. A. Fling.

AURORA, IND.—The Southern Indiana Telephone Company has been incorporated with a capital stock of $10,000. Directors: E. W. Swarthout, F. B. Shutts and W. H. O'Brien.

TULSA, I. T.—Articles of incorporation for the Tulsa Street Railway Company has been filed with J. M. Hall, president; P. L. Price, vice-president; Dr. Fred S. Clinton, secretary; J. D. Hagler, treasurer, all of Tulsa. The capital stock is $200,000.

KEOSAUQUA, IA.—Articles of incorporation have been filed by the Iowa-Missouri Traction & Power Company.

NORTHWOOD, IA.—The Northwood Electric Light & Power Company has been incorporated with a capital of $25,000.

FAIRFIELD, IA.—The Fairfield, Birmingham & Keosaqua Railway Company will be incorporated in a few days, for the purpose of constructing an electric interurban railway from Fairfield via Birmingham to Keosauqua, a distance about 20 miles. The power for operating the system is to be secured by damming the Des Moines River at Keosauqua.

IOWA CITY, IA.—The Iowa City, Montezuma & Des Moines Railway Company was organized here recently for the purpose of constructing an electric railway from Iowa City via Williamsburg to Montezuma, the county seat of Poweshiek County. The proposed line will be about 58 miles long. The officers of the company are: G. W. Ball, of Iowa City, president; J. W. Carr, of Montezuma, vice-president; W. J. Welch, of Iowa City, secretary, and C. R. Clark, of Montezuma, treasurer.

GRAYSON, KY.—The organization of the Grayson Electric Light Company has been completed. The company has a capital stock of $5,000. The officers are as follows: Jerome Duvall, secretary; W. A. Horton, treasurer; J. N. Hubbard, general superintendent. G. W. Armstrong and J. W. Strother will have charge of the construction of the plant.

AUGUSTA, ME.—Articles of incorporation have been filed with the Secretary of State by the Dixfield Light & Improvement Company, with a capital stock of $50,000. The officers are: L. J. Coleman, of Gardiner, president; A. M. Macomber, of Augusta, treasurer.

PORTLAND, ME.—The Pensacola Electric Company has been organized for the purpose of constructing, operating and maintaining railways operated by electricity, steam or other power. The company has a capital stock of $1,300,000. The officers are: President, Charles M. Drummond, of Portland; secretary and treasurer, John C. Rice, of Boston, Mass.

BYRON, MINN.—The Cass County Telephone Company has filed articles of incorporation with a capital stock of $10,000. The incorporators are F. D. Deline, J. O. Jesme, of Leader; F. H. Clayton, Esterly.

APPLETON CITY, MO.—Articles of incorporation have been filed for the Appleton City & Rockville Telephone Company with a capital stock of $25,000 by E. A. Hook and others.

ALLIANCE, NEB.—The Ranch Telephone Company has filed articles of incorporation with a capital stock of $10,000. The directors are William M. Hill and others.

FARGO, N. D.—The North Dakota Independent Telephone Company has been incorporated with a capital stock of $3,000,000. The purpose of the company is to consolidate all the independent telephone companies in the northern part of Dakota. The company now has more than 3,000 miles of toll lines under its control. The officers of the company are as follows: President, H. P. Lyon, of Mandan; vice-president, Robert Jones, of Fargo, and J. D. Brown, of Hope; secretary, A. B. Cox, of Valley City; treasurer, E. H. Weiser, of Fargo.

JERSEY CITY, N. J.—The Zanzibar Electric Light Company has filed articles of incorporation with a capital stock of $100,000. The incorporators are: B. Stafford Mantz, Thomas F. Barrett and Felix Ingold.

NEW YORK, N. Y.—Articles of incorporation have been filed with the Secretary of State for the Superior Electric Company, with a capital stock of $40,000. The directors are C. F. De Soria, Irene M. De Soria and N. M. Watson, of New York.

ADDISON, N. Y.—The Tuscarora Traction Company has filed articles of incorporation with the Secretary of State for the purpose of constructing a street surface road between Addison and Jasper, a distance of 18 miles. The company has a capital stock of $500,000. The directors are Thomas E. Harden, of Addison; Joseph W. Borst, of Painted Post; George R. Brown, of Elmira.

ELMIRA, N. Y.—The Elmira & Seneca Lake Traction Company, the company which recently purchased the property and franchises of the Elmira & Seneca Lake Railroad Company from Henry M. Beardsley, receiver, has been incorporated with a capital of $200,000. The prinicipal office is in Watkins, Schuyler County. Among the directors are William H. Wadhams, Murray W. Dodge, A. S. Cook and L. B. Grant, all of New York City.

PEEKSKILL, N. Y.—The Putnam & Westchester Traction Company has been chartered with a capital stock of $75,000 to operate an electric railway from Peekskill, Westchester County, to Oregon, Putnam County, a distance of nearly 34 miles. The directors are J. L. Ladd, and O. L. Ehardt, Peekskill, and W. A. Perry, Putnam Valley.

COLUMBUS, OHIO.—Articles of incorporation have been filed for the Kelly Island Telephone & Electric Company, with a capital stock of $10,000, by Norman C. Upp and others.

GUTHRIE, OKLA.—The Newkirk, Tonkawa & Southern Electric Railroad Company has been chartered with a capital stock of $1,500,000 to construct an interurban railway from Newkirk to Oklahoma City. The incorporators are M. P. Brown, J. S. Kerfoot and H. E. Elder, of Oklahoma City; Thomas S. Smith, of Newkirk, and E. G. Warfield, of New York. The main office is at Oklahoma City.

READING, PA.—The Berks Light Company has been chartered with a capital stock of $10,000 by George M. Whitney and others.

PIERRE, S. D.—The Riverside Telephone Company has filed articles of incorporation with a capital stock of $2,500. The incorporators are Asa Rambo and others.

WALLING, TENN.—The Walling Light & Power Company has been incorporated, with a capital of $10,000 by Jesse Walling, S. J. Stroud and others.

DALLAS, TEX.—The North Texas Securities Company, of Dallas, has been formed, to construct water, gas and electric plants in four towns in Texas.

HILLSBORO, TEX.—The Hillsboro Telephone Company has been incorporated with a capital stock of $200,000 by N. H. Davenport and others.

DALLAS, TEX.—The Fair Park Scenic Railway Company has been chartered with a capital stock of $30,000. The incorporators are A. H. Burns, H. Hill, R. L. Cameron and P. G. Cameron.

SANTIAM, WASH.—The Santiam Electric Company has been incorporated by W. P. Hawley, H. L. Pittock, Joseph M. Healy and F. W. Leadbetter, with a capital stock of $250,000.

New Industrial Companies.

THE WESTERN ELECTRIC PIANO COMPANY, of St. Louis, Mo., has been chartered with a capital stock of $15,000 by Joseph Rossman and associates.

THE FAIRBANKS-MORSE ELECTRICAL MANUFACTURING COMPANY, of Indianapolis, Ind., has been incorporated with the object of doing an electrical manufacturing business. The capitalization is $150,000. The directors are Chas. H. Morse, Walter E. Miller and S. L. Hadley.

KUMBERGER & VREELAND, of New York, N. Y., have filed articles of incorporation with the Secretary of State with a capital stock of $150,000. The company propose to manufacture gas engines. The directors are H. J. Kumberger, Mathilda E. Kumberger and T. B. Taylor, of New York, N. Y.

THE WORTH MANUFACTURING COMPANY, of Evansville, Ind., has been incorporated to establish a plant and manufacture automobiles, motor vehicles, motor cars, motors, motor appliances and electrical supplies of all kinds. The capital stock is $100,000. James W. Worth is president and Jno. C. Zutt, secretary.

THE McMYLER MANUFACTURING COMPANY, of Cleveland, Ohio, has commenced work on a large electrical car dumping outfit and two conveyors to be erected for the British government at Natal, South Africa. The machinery will all be electrically driven and a power plant will be erected in connection with the outfit.

THE SAUVE ELECTRIC COMPANY, of Spokane, Wash., has filed articles of incorporation with the county auditor with a capital stock of $750,000. The company proposes to deal in electrical appliances and commodities of all kinds, and in patent rights and inventions. The trustees are S. H. Sauve, J. H. Robbins, C. C. Robbins and Thomas J. Purcell.

THE A. R. MACOMBER COMPANY, of Attleboro, Mass., has filed articles of incorporation with a capital stock of $10,000. The purposes of the company are to manufacture electrical supplies, electrical construction and general electric work. The company will absorb the business formerly conducted by A. R. Macomber in Attleboro. A. R. Macomber is president and treasurer.

Legal.

DIVIDED POLE FIELD WINDING.—In the case of the Emerson Electric Mfg. Co. vs. Century Electric Company, both of St. Louis, heard before Judge Finkelnburg in the United States Circuit Court for the Eastern Division of the Eastern Judicial District of Missouri, a decree was entered July 9 in favor of the complainant, with reference to a master of the court for an accounting. This case was a suit for infringement of patent No. 583,933, dated June 8, 1897, and especially of claim 5 of said patent, covering the "pyramidal" or "divided pole" form of field winding, now extensively used on alternating current fields on account of its economy and efficiency. This patent was issued to E. S. Pillsbury and assigned to the Emerson Company. Claim 5 covers the form of winding in which on a divided pole a graded magnetization is obtained by winding one coil around the central prong of a pole, another coil around three of the prongs, including the central one, the next coil around five of the prongs, including the other two coils, and so on. The benefit of this winding is that it gives the same magnetization as the older form of basket winding, but is more economical in material and requires less wire space for a given output.

Obituary.

MR. C. C. MILLER.—Mr. Charles C. Miller, for many years connected prominently with the Westinghouse Air Brake Company, at Pittsburg, Pa., and later treasurer of the Peerless Rubber Company, of 16 Warren street, New York, died on July 17, at Long Branch, N. J., of progressive paralysis, in his sixty-fifth year. He was born at Pittsburg, where he married Miss Sarah Lavan eleven years ago. He retired from business eight years ago, and two years ago he moved to Long Branch. He is survived by one brother and five sisters. The brother is Mr. Orlando Miller, purchasing agent for the Westinghouse interests at Pittsburg.

Personal.

MR. FRANCIS S. THAYER has resigned as superintendent of the Norwich Municipal Gas & Electric Department.

MR. ALONZO R. WEED has been appointed by Governor Guild a gas and electric light commissioner for the State of Massachusetts.

MR. P. F. SULLIVAN, president of the Massachusetts Electric Companies, has taken a trip to Europe, and will be gone several weeks.

ALLEN-CALLAWAY.—Mr. Livy Duncan Allen, of the Allen Electric Company, of Chicago, was married June 21 to Miss Abbie L. Callaway, of La Grange, Ga.

MR. T. A. EDISON has come into possession of the place near Milan, Erie County, where he was born. The transfer is made by the granddaughter of Edison's sister.

MR. G. M. BROWN, manager of the Central Union Telephone Company, at Alton, has resigned his position to go to Keokuk, Ia., to become manager of an exchange there.

MR. B. C. ADAMS, late superintendent of distribution for the Madison (Wis.) Gas & Electric Company, was appointed general superintendent of the Lincoln, Neb., Gas & Electric Light Company.

MR. F. H. MASON, Detroit, Mich., has been appointed representative for the Alphons Custodis Chimney Construction Company for the State of Michigan. He will continue his other agencies.

MR. ANDREW CARNEGIE is said to have began his autobiography in America last winter and to be hopeful of finishing it during his stay at his Scotch residence, Skibo Castle, this summer.

MR. P. G. GOSSLER, vice-president of J. G. White & Co., has gone to Porto Rico, West Indies, on business connected with the electric railway and lighting properties operated by the company in that island.

MR. J. D. ZOOK, who was for some time superintendent of the Gregory Electric Company, of Chicago, and left it to take a position with a concern in the northwest, has returned recently to the Gregory ranks, resuming his old duties.

MR. W. S. KILMER, illuminating engineer, formerly with the Electrical Testing Laboratories, New York City, has become connected with the engineering department of the Holophane Glass Company, at 227 Fulton Street, New York.

MR. W. MILLS, formerly superintendent of the Eastern Carbon Works, of Jersey City, N. J., has resigned from that company recently, and is now interested in, and superintendent of, the Stackpole Battery Company, of St. Mary's, Pa.

MR. GEORGE W. BOTHAM has resigned as superintendent of the Dayton & Western Traction Company, to go with the Northern Electrical Manufacturing Company, of Madison, Wis., with which company he was identified before going into the operating end of the traction business.

MR. HARRY M. HOPE, formerly electrical engineer of the North Shore Electric Company, operating in the suburban districts surrounding Chicago, will leave that company's employ Aug. 1, to become manager of the switchboard department of the J. Lang Electric Company, manufacturer of switchboards and switchboard appliances, at Chicago.

MR. E. W. STEVENSON, chief electrician of the Hazard Manufacturing Company, of Wilkesbarre, and in charge of its insulated wire and cable work, has just returned from a visit to his old home in England, where he spent several weeks with his family and participated in the entertainments given by the Institution of Electrical Engineers. Mr. Stevenson describes the hospitality as royal, and the various excursions as most interesting.

MR. E. W. PHILLIPS has resigned his position as general agent of the Edison Electric Illuminating Company, of Brooklyn, to assume the management of the Edison Construction Company, a newly organized corporation which will do electrical engineering and construction work in Brooklyn. Mr. J. F. Becker, Jr., becomes general agent, and Mr. M. S. Seelman, Jr., becomes associate general agent in addition to continuing the management of the advertising department of the progressive Brooklyn system.

MR. WILLIAM H. OWENS has been appointed general manager of the electric light and power utilities of Granite City, Venice and Madison, to take office at once. He has been in charge of the Edwardsville light and power plant since last February. These properties are owned by the McKinley syndicate, which operates municipal utilities and interurban and city lines in Illinois. Mr. Owens, who is 25 years old, graduated from the Unversity of Illinois in 1902.

MR. C. P. STEINMETZ is the subject of a full page illustrated interview and biographical sketch in the Boston *Herald* of July 8, in which he is shown in various attitudes and in which ideas, opinions and facts are set forth by him with all the modesty and reserve becoming a great man when publicity is thrust upon him. He is quoted as favoring the direct-current motor for railway work. The farmer is to be the next electrical beneficiary, but energy will be furnished to him by specially organized companies rather than by the trolley companies.

MR. W. CORIN, city electrical engineer, of Launceston, Tasmania, forwards us his annual report on the city municipal lighting plant, which last year was changed over to the three-phase system. Since that time 58 new transformers have been installed and 1,600 customers transferred. The total revenue from the plant was $65,000 and the surplus was $7,500. The maximum load is about 600 kilowatts, and the new plant is rated at a capacity of about 1,200. There has been a rapid increase in motive power supply, and 424 b.h.p. is now connected. It is also stated that there are 355 customers for electric heating using 181 kw.

MR. J. W. CHRISTIE, who, through his long connection with the Northwestern Telephone Exchange Company, is one of the best known telephone men in the West, has been appointed treasurer of the company, with headquarters in Minneapolis. Heretofore this important office has been located in Boston, but President Pettengill, whose papreciation of the importance of Minneapolis as a telephone center induced him to remove his own office to that city some two years ago, wanted his treasurer at his elbow. Mr. Pettengill also wanted a practical telephone man to occupy the treasurer's office, and this led to Mr. Christie's appointment, which is a distinct promotion, and one which is highly gratifying to him afer his long years of service.

MR. W. M. DEAN.—The Siskiyou Electric Power Company has secured the services of Wm. M. Dean as general manager, and Mr. Dean will have charge of the rebuilding of the entire Ashland system for the Ashland, Ore., Electric Power & Light Company. Mr. Dean was engaged in the erecting of the Newcastle plant of the Central California Electrical Company in California and afterwards erected the Auburn plant, for the same company. He was superintendent of the Independent Electric Light & Power plant installed by Claus Spreckles, in San Francisco, and superintendent of the American River Electric Company and installed their equipment in Stockton, Cal. After that plant was put in perfect running, Mr. Dean went to Korea to install a big electric plant and has just returned from there, having remained to see the successful operation of the plant. On arrival in San Francisco, he was immediately put in charge of the reconstruction of the wiring of the San Francisco Gas & Electric Company, resigning to accept the place of engineer with the Siskiyou Electric Power Company.

MR. H. W. TURNER, after having completed a two years' engagement at the works of the British Westinghouse Co. as engineer in charge of the winding and insulation division of the electrical engineering department, and also as superintendent of the winding and insulation department in the works, has associated himself with Mr. H. M. Hobart, consulting engineer of Oswaldestre House, Norfolk Street, Strand, London, and will be engaged in advising with regard to manufacturing methods, machinery and shop organization. Mr. Turner in the course of an experience of over twenty years in responsible positions with the British Thomson-Houston and British Westinghouse Companies, the Union Elektricitats Gesellschaft, Berlin and Vienna, and the Thomson-Houston Electric Company of the United States, has diagnosed, reported and advised in hundreds of questions arising not only in the manufacture, but also in the subsequent outside use of dynamo electrical machinery, and he now proposes to independently advise clients (both manufacturers and users) in these and related matters. This arrangement will not interefere with Mr. Hobart's regular consulting practice, together with the giving of specialized advice on the design and standardization of dynamo-electric machinery of all classes.

MR. J. H. DENTON, who was general superintendent of the National Brake & Electric Company, has been engaged to act as manager of the new air brake department of the Allis-Chalmers Company, which secured control recently of the Christensen patents, and he will be surrounded by a staff of men who have been especially trained in this branch of manufacture. Mr. F. C. Randall, formerly vice-president and general manager of the National Electric Company, for the past year has been manager of the New York district office of the Allis-Chalmers Company, and, owing to his intimate acquaintance with the manufacture and application of air brakes, is exceptionally well qualified to advise with traction men on this subject; Mr. W. W. Power, formerly manager of the National Brake & Electric Company's Philadelphia office, was recently appointed manager of the Philadelphia district office of the Allis-Chalmers Company; Mr. Geo. C. Voigt, formerly of the National Electric Company, has lately identified himself with the Allis-Chalmers Company, and will have charge of air brake sales in Western territory, and Mr. Geo. C. Dresser, until recently with the National Brake & Electric Company, is to be attached to the Allis-Chalmers Company's New York office, as a special air brake representative.

Trade Publications.

COAL-HANDLING MACHINERY.—The Robins Conveying Belt Company, New York, has issued bulletin No. 15, illustrating conveying and elevating machinery in retail coal pockets and locomotive coaling stations.

H. T. PAISTE COMPANY, Philadelphia, have issued Bulletin No. 33, for July, dealing with their panel cut-outs for rotary switches. These are illustrated fully and carefully described in a snappy, switchy way.

CORLISS ENGINES.—In an elaborate catalogue, designated as No. 56, the Murray Iron Works Company, Burlington, Iowa, describes and illustrates a complete line of Corliss engines, high-pressure boilers and complete power plants.

STEEL TANKS are the subject of an oblong pamphlet, Bulletin No. 40, issued by the Oswego Boiler & Engine Company, of Oswego, N. Y., illustrating and describing their work in this line, and giving lists of different sizes and wall thickness.

MOTOR-DRIVEN AIR COMPRESSORS.—Much information concerning the constructional features of direct-current motor-driven air compressors of the geared type is contained in bulletin No. 4444 of the General Electric Company, Schenectady, N. Y.

TURBO-GENERATORS.—Bulletin No. 4445 of the General Electric Company, Schenectady, N. Y., describes in detail direct-current Curtis steam turbo generators of the horizontal type. The generators are equipped with auxiliary poles to prevent sparking at the commutators.

DIRECT RAILWAY MOTORS.—The General Electric Company, Schenectady, N. Y., has issued bulletin No. 1442, devoted to the G E-87 railway motor. This motor is rated at 60 hp. at 500 volts; the speed depends upon the gear ratio, being 10.6 miles per hour at a ratio of 4.44 to 1, and 17.1 m.p.h. at 2.78.

CORE-TYPE TRANSFORMERS.—Bulletin No. 65 of the Crocker-Wheeler Company, Ampere, N. J., gives much valuable information concerning the construction and operation of core-type transformers for high-tension power transmission. These transformers were described at great length in our issue for January 6, 1906.

CORE-TYPE TRANSFORMERS.—In bulletin No. 4441 the General Electric Company, Schenectady, N. Y., illustrates and describes a complete line of core-type transformers for underground installations. These transformers are equipped with water-tight cases, filled with oil to assist in insulating and cooling the coils and core, and provided with external corrugations to give the necessary radiating surface.

TELEPHONE EXCHANGE.—The Bell Telephone Company, of Philadelphia, Pa., has issued a neatly illustrated booklet devoted to a description in detail of the Lombard central office at Fourth and Manning Streets. The company has issued an invitation to all parties interested to

inspect the Lombard exchange, which is believed to possess enough of novel interest to compensate for the time consumed.

COMMON BATTERY TELEPHONES.—The Dean Electric Company, of Elyria, O., has just issued "Bulletin No. 102," dealing with common battery telephones and describing its various apparatus adapted to this purpose. The pamphlet is, indeed, an excellent little treatise on the subject, using the Dean circuits and telephones as illustrative material. Special interest attaches to the harmonic converter vibrators shown employed for selective purposes. This method is explained very fully.

FUSE WIRE.—The Chicago Fuse Wire & Manufacturing Company, 170 South Clinton Street, Chicago, have just issued bulletin No. 18, on their "Union" enclosed fuses, blocks and fittings. It is in very handy and condensed form, convenient for reference, and has an excellent feature of merit on pages 12 and 13, showing diagrams of ferrule and knife blade contacts and giving dimensions of all the National Code standard fuses.

BUFFING MOTORS.—The Holtzer-Cabot Electric Company, Brookline, Mass., has issued a special publication dealing with electric lathe motors for buffing, polishing, grinding and kindred uses. The company expresses its willingness to ship a lathe motor on trial to any responsible person or concern. Circulars outlining the features of the motors and telling of the special trial proposition will be sent to interested parties upon request.

MOTORS AND DYNAMOS.—Allis-Chalmers motors and dynamos are illustrated and described quite fully in Bulletin No. 1052, dealing particularly with type B, both bipolar and multipolar. The machines in this category do not run into large sizes, but are applicable to a wide range of direct current work. The range is up to 25 hp. in motors, and 17½ kw. slow speed generators, and 25 kw. in moderate speed generators. The motors are built either enclosed or with screen covers; and they can be operated on floor or ceiling, direct connected, belted or geared.

"THE EDISON PEOPLE" is one of a number of excellent pieces of literature issued recently by the New York Edison Company. It contains more than 50 of the clever Cooper "Colonial" drawings, in two colors, illustrative of the uses of electricity possible with the Edison system; and this is supplemented by a good deal of data. No fewer than 50,000 copies of this attractive pamphlet have been issued. Another admirable brochure deals with the use of electricity in building construction, by hitching into the Edison mains, as has been done by the New York Central and Pennsylvania railroads for the immense terminal facilities in New York. A third striking piece is the folder giving a view of the huge reserve coal piles of the New York Edison Company at Shadyside, New Jersey. The July issue of the company's *Bulletin* just to hand is one of the daintiest but most effective of all that class of publications, beautifully illustrated, and with several cogent and convincing articles on the practical every-day uses of electrical energy.

News of the Trade.

STANDARD VARNISH WORKS, 29 Broadway, New York city, have installed a plant on the Passburg system, for the vacuum drying and impregnation of armature and field coils with solid compounds. They invite correspondence as to free experiments.

THE KEOUGH GRIP.—Mr. V. C. Gilpin, 120 Liberty Street, New York City, has been made general sales agent for Keough Bros. & Co.'s electrical specialties, including the new and effective Keough cord grip, permitting the use of reinforced cord with ⅛-inch sockets.

ITHACA ELECTRIC CONTRACTING CO., of 112 North Aurora Street, Ithaca, N. Y., is the outcome of the recent consolidation of the electrical firms of H. A. Waldron and Corman & Temple. It is the intention of the new concern to build up a small jobbing trade as well as to handle contracting work, in all departments of light, power, annunciator installations, etc. The new firm would like to be put on the mailing lists of all jobbers and manufacturers of electrical supplies and fixtures.

THE ALBERT & J. M. ANDERSON MFG. CO. has appointed the W. R. Garton Company, of Chicago, Ill., sales agent for its overhead line material and Aetna insulators for electric railways. The Garton Company will carry a stock of Anderson material in its storehouses, and is particularly well equipped by reason of its long experience in the railway supply line, and its ability to furnish other material required by electric railways, to understand and meet the requirements of engineers and purchasing agents.

BOILER COMPOUND CONTRACT.—The United States Treasury Department has awarded the annual contract for boiler compound to the Geo. W. Lord Company, of Philadelphia. An analysis of feed water for each of the many government buildings is made several times per year by Lord's laboratory and special chemicals for each case supplied by them. The Geo. W. Lord Company was originators of manufacturing boiler compounds in this scientific manner and the United States as well as several other governments have adopted its products as standard.

COMPLETE POWER PLANTS.—At the present time there are comparatively few concerns in America that build both the engine and the generator. Prominent among these is the B. F. Sturtevant Co., of Boston, Mass., whose name is almost synonymous with "blower." It is certainly a misfortune that this world-wide reputation as blower manufacturers has partially obscured the magnitude of its business in engines, motors and generating sets. In fact, however, the B. F. Sturtevant Co. has for years made a specialty of high-grade generating sets, with the engine and generator designed each for the other, and combining maximum efficiency with minimum space and weight; elements which are particularly essential in machinery built for export. This company now catalogues no less than thirty-six different sizes and types of units ranging from 3 to 100 kw. Each is absolutely complete in its parts, being carried upon a bed plate which is common to both. The size and weight of all but the larger sizes are such as to permit of export shipment without separating of parts, so that the machine stands ready for operation as soon as it is unpacked.

THE PELTON WATER WHEEL COMPANY has practically completed its new works located at 19th and Harrison Streets, San Francisco, and will be in complete running order by September 1. These shops were under construction before the fire, according to plans carefully prepared; consequently, they are entirely permanent—not designed under emergency conditions—and will afford the most modern facilities for handling and turning out high-grade work. Through its New York works and temporary San Francisco works, the Pelton Water Wheel Company, has been executing orders as usual, and has booked new orders which will enable it to run at full capacity for many months to come. The Pelton-Francis turbine, recently placed on the market by this company, has contributed its share to this season's work and is proving a valuable adjunct to the company's business. This is a new departure in water wheel practice, and is attracting the attention of engineers generally. The Pelton Water Wheel Company is temporarily located at 517 Market Street, San Francisco, but expects to be permanently located in the Monadnock Building, San Francisco, by August 15.

RICHARD PLANIMETER.—Mr. E. H. du Vivier, 14 Church Street, New York City, is introducing a perfected form of the Richard planimeter, made by Jules Richard, of Paris. It is 13¾ inches long, 9 inches high, 9½ inches wide, and 21 pounds in weight—altogether a very compact and convenient instrument. It has been constructed for the purpose of integrating curves having curvilinear ordinates, as shown on "Richard" recording instruments. It allows one to also measure the diagrams on steam indicators or any other curve closed or open having rectilinear ordinates. When the axis of the diagram corresponds to that of the planimeter, one may measure several curves, one after the other, without returning each time to zero, and without bringing the pointer back to the starting point. Any electrical station engineer will readily appreciate, among its other advantages, how this instrument can be applied for dissecting load curves as shown by a recording wattmeter or ammeter. In other words, by its use, it is possible to determine the number of amperes or the number of watts used between any two given periods. This, of course, is only possible when straight charts are used on which the recording pen moves the same distance, whether it be on the upper or lower part of the chart. As the charts used on the Richard instruments are of this class, they may all be integrated.

Weekly Record of Electrical Patents.

UNITED STATES PATENTS ISSUED JULY 10, 1906.
[Conducted by Rosenbaum & Stockbridge, Pat. Attys., 140 Nassau St., N. Y.]

824,701. MULTIPARTY-LINE EXCHANGE SYSTEM; Garrison Babcock, Chicago, Ill. App. filed Nov. 30, 1903.

824,756. SYSTEM OF ALTERNATING-CURRENT-MOTOR CONTROL; August Sundh, Yonkers, N. Y. App. filed Mar. 10, 1905.

824,767. TELEPHONE-EXCHANGE SYSTEM; Harry G. Webster, Chicago, Ill. App. filed Mar. 25, 1903.

824,828. SECONDARY-BATTERY PLATE; William L. Silvery, Dayton, O. App. filed Mar. 5, 1906.

824,843. OPERATOR'S KEY FOR TELEPHONE SWITCHBOARDS; William M. Brown, Johnstown, Pa. App. filed June 26, 1901.

824,893. MAGNETIC ORE-SEPARATOR; Joseph Wetherby, Jr., New Cumberland, Pa. App. filed Aug. 3, 1905.

824,980. TELEPHONE SYSTEM; William W. Dean, Chicago, Ill. App. filed Nov. 9, 1903.

825,056. METHOD OF TREATING NICKEL-COPPER MATTE; Woolsey M. Johnson, Iola, Kans. App. filed Sept. 30, 1903.

825,057. METHOD OF TREATING SULFURIC ACID; Woolsey M. Johnson, Iola, Kans. App. filed Oct. 10, 1903.

825,134. ATTACHMENT FOR TELEPHONES; Albert G. Kountz, Mount Oliver, Pa. App. filed Jan. 22, 1906.

825,222. DYNAMO-ELECTRIC MACHINE; Marius C. A. Latour, Sevres, France. App. filed Nov. 21, 1902.

825,234. PROCESS OF PRODUCING CALCIUM CARBID; John M. Morehead, Chicago, Ill. App. filed Mar. 24, 1905.

825,286. GROUND DETECTOR AND CUT-OUT; Ernest F. D. Alexanderson, Schenectady, N. Y. App. filed Sept. 14, 1904. Designed to prevent grounds of three-phase system having a grounded neutral point, providing a protective means for detecting grounds which is very sensitive. The circuits are arranged to apply to the ground detector a current proportional to the algebraic sum of the currents in the three phases.

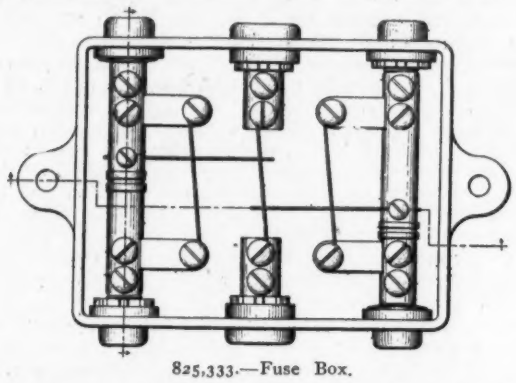
825,298. ELECTRIC CAR HEATER; Harold W. Buck, Niagara Falls, N. Y. App. filed Dec. 8, 1900. In order to economize the current required for heating a car in winter, the patentee provides an air pipe which leads from the casing to the usual motor and circulates throughout the body of the car so as to apply the waste heat of the motor.

825,299. SUPPORT AND HANGER; Joseph T. Bunn, Washington, D. C. App. filed Jan. 19, 1905. The trolley is suspended from long depending hangers, each of which is supported by four separate guy wires so as to be sufficiently stiff against lateral strains. The purpose is to have the guy wires a considerable distance above the trolley in order that they may not interfere with any guards or similar devices used therewith.

825,318. BLOCK SIGNAL SYSTEM; Laurence A. Hawkins, Schenectady, N. Y. App. filed Jan. 25, 1905. The semaphore signals move into three positions corresponding to danger, caution and safety. The signals are motor operated, and magnet operated detents control the position at which the semaphore is set.

825,333. FUSE BOX; Peter C. Morganthaler, Fort Wayne, Ind. App. filed July 29, 1905. Designed to provide a cut-out for a three-wire system so arranged that if a customer attempts to short circuit one side of the system in order to stop his watt meter, the other side will also be cut out automatically, and all three legs of the system open circuited.

825,367. CONTROLLER; Harold E. White, Schenectady, N. Y. App.



825,333.—Fuse Box.

filed Nov. 11, 1905. A controller specially adapted for moving the turrets of battle ships. Has a dial plate co-axial with the controller handle on which is always indicated the position of the turret. The invention lies in a system of gearing by which this dial plate is kept statonary without the use of awkward brackets.

825,386. ELECTRIC FURNACE; J. F. Hammond, Brewster, N. Y. App. filed Sept. 18, 1905.

825,393. CONTROLLING SWITCH FOR MOTOR-OPERATED DOORS; James W. Kellogg, Schenectady, N. Y. App. filed June 20, 1904. A manually operated reversing switch having both operative positions on the same side of its off position, and means controllable from a distance for moving said switch into an operative position.

825,396. ELECTRICALLY CONTROLLED RAILWAY SWITCH; Frederick T. Kitt, Denver, Col. App. filed July 18, 1904. Relates to track switches in which the switch point is thrown to alternate positions by successive closures of a single circuit. A solenoid armature has a pin dropping into a crown-shaped cam so as to step the solenoid around at each actuation.

825,397. TELEPHONE HOOK-SWITCH; H. L. Knight, Cleveland, O. App. filed Mar. 15, 1905.

825,405. CONDENSER AND PROCESS OF MAKING SAME; Maurice K. McGrath, Chicago, Ill. App. filed Nov. 28, 1902. The process of making condensers which consists in assembling strips of tinfoil and paper in a flat roll, reversely folding the flat roll into an S shape, treating the same with melted paraffin wax or the like, placing the folded roll in a narrow rectangular mould and subjecting the same to continued pressure while allowing the wax to cool and set.

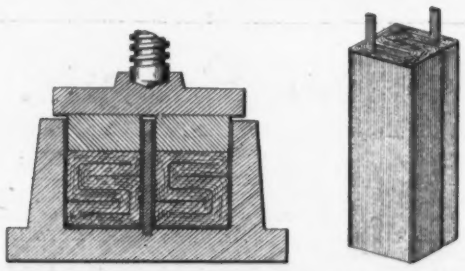
825,406. POLARIZED MAGNET DEVICE; Maurice K. McGrath, Chicago, Ill. App. filed Jan. 11, 1904. Has only a single magnetizing helix which lies between the poles of a permanent magnet. The bell clapper is pivoted co-axially with this magnet helix.

825,424. MEASURED-SERVICE SYSTEM OF TELEPHONE EXCHANGES; C. E. Scribner, Jericho, Vt. App. filed Feb. 6, 1905.

825,434. ELECTRICAL LAMP FIXTURE; Nelson Weeks, Richmond Hill, N. Y. App. filed June 21, 1901. A cluster lamp socket having a casing which carries the threaded shells insulated from the casing by porcelain bushings, and having a porcelain base which carries clips forming the central stud contacts for the lamps.

825,439. SPECIAL BUSY TEST FOR TELEPHONE LINES; C. S. Winston, Chicago, Ill. App. filed Dec. 22, 1904.

825,443. ELECTRIC LAMP HOLDER; Reuben B. Benjamin, Chicago, Ill. App. filed May 7, 1903. Relates to modifications of the above



825,405.—Condenser and Process of Making Same.

and particularly a construction adapted for two lamps. The threaded shells are carried by the leaves of a V-shaped plate.

825,444. ELECTRIC LAMP SOCKET; Reuben B. Benjamin, Chicago, Ill. App. filed Feb. 27, 1904. A weather proof lamp socket having a cup-shaped porcelain frame contained in a metal casing. The porcelain frame has attached therein the metallic clips which form the terminals of the socket.

825,488. PUSH BUTTON; Frederick A. Schneider, Toronto, Canada. App. filed Mar. 21, 1905. A device for closing a plurality of signal circuits. Has a handle connected by a flexible cord to a fixed point, said handle having the various push buttons and switches specially arranged thereon,

825,501. TROLLEY WHEEL; Charles F. Wilson, New York, N. Y. App. filed Jan. 17, 1905. A cheap construction of trolley wheel, having sheet metal flanges which are riveted to the central portion of the wheel and which constitutes the tread thereof.

825,509. FIRE ALARM SYSTEM; B. F. Beane and R. P. Bennett. App. filed Dec. 7, 1905. Details of a fire alarm system having a clock train which drives the circuit breaker, and magnet operated trips for starting the clock train into motion.

825,538. INDUCTIVE BOND; Lemuel F. Howard, Edgewood, and Philip B. Rice, Wilkinsburg, Pa. App. filed Mar. 2, 1906. An inductive bond for electric railways having a generally triangular conductor, two parts of which lie parallel to one another for a certain distance. This portion is wound with iron wire so as to give an inductive effect.

825,623. COMBINED TELEPHONE AND ALARM SYSTEM; H. G. Webster, Chicago, Ill. App. filed Apr. 26, 1904.

826,624. COMBINED TELEPHONE AND ALARM SYSTEM; H. G. Webster, Chicago, Ill. App. filed July 11, 1904.

825,625. COMBINED TELEPHONE AND ALARM SYSTEM; H. G. Webster, Chicago, Ill. App. filed July 11, 1904.

825,626. COMBINED TELEPHONE EXCHANGE AND ALARM SYSTEM; H. G. Webster, Chicago, Ill. App. filed Oct. 10, 1904.

825,632. ELECTRIC SWITCH; Charles F. Black, Dayton, O. App. filed July 28, 1905. A push button having a pawl thereon, which engages a ratchet wheel to successively rotate the same when the push button is depressed. The ratchet wheel carries blades which alternately make and break a local circuit.

825,635. TELEPHONE TRANSMITTER; E. C. Brewer, St. Louis, Mo. App. filed Jan. 19, 1906.

825,664. ELECTRIC IGNITER; Henry M. Kolb, Philadelphia, Pa. App. filed Oct. 10, 1905. A gas lighter comprising a bar having a lever pivoted thereto, said lever extending to a point within convenient reach of the operator's hand. Manipulation of this lever makes and breaks a circuit at the end of the rod.

825,672. MAGNETIC ORE SEPARATOR; Richard R. Moffatt, Brooklyn, N. Y. App. filed July 19, 1904. A continuous belt is guided between the pole pieces of a large field frame, one of the pole pieces of which is laminated and removable. Different pole pieces may be substituted to suit varying grades of ore.

825,685. COMBINED TELEPHONE EXCHANGE AND ALARM SYSTEM; H. G. Webster, Chicago, Ill. App. filed Oct. 17, 1904.

825,687. STEAM AND GAS GENERATOR; Friedrick A. Weigel and Isaac Wolf, Johnetta, Pa. App. filed Oct. 5, 1905. Details of construction of a plan for making steam and gas by electrolyzing water in an enclosed chamber.

825,734. SWITCH OPERATED SIGNAL LIGHT; George W. Jordan, Purvis, Miss. App. filed Sept. 26, 1905. A pair of spring blades are held in proximity to the rails so as to be pressed into engagement with one another by the wheel flanges of a passing train.

825,781. TROLLEY; John H. Walker, Lexington, Ky. App. filed Sept. 9, 1905. A trolley harp having upper and lower prongs and conduit

825,672.—Magnetic Ore Separator.

leads extending beneath the lower and upper prongs, the upper prongs having portions overlying the conduit leads and the lower prongs having portions underlying the said leads.

825,795. INSULATOR; Melvin F. Baker, Lewiston, Mont. App. filed July 25, 1905. A two-part porcelain insulator has grooves to receive the wires and a central bolt which passes downward into a wooden box-shaped supporting pin or base.

825,823. BURGLAR AND FIRE ALARM; Truman D. Goresline and Judson M. Cramer, Gardner, Kans. App. filed June 7, 1904. A clock-driven fire alarm having a magnet operated trip.

825,830. VIBRATING MECHANISM FOR INTERRUPTING CURRENTS IN SPARK COILS; John O. Heinze, Jr., Lowell, Mass. App. filed Sept. 19, 1905. In order to increase the strength of magnetization of an induction coil so as to make the vibrator work more rapidly, the patentee provides iron plates which lie alongside the vibrator and are inductively magnetized by the remote pole of the induction coil so as to exert an attraction on the vibrator in conjunction with the near pole.

825,833. ELECTRIC CLOCK; Robert L. Hight, Decatur, Ill. App. filed Aug. 31, 1905. Provides an improved construction by which the clock may be wound by a rotary motor having an intermittent motion, said motion being controlled by contact means carried on the shaft of the escapement wheel.

825,837. SEPARATOR FOR SECONDARY BATTERY PLATES; Leonard W. Horton, Providence, R. I. App. filed Mar. 17, 1904.

825,838. ELECTRIC SWITCH; Edward B. Jacobson, Pittsfield, Mass. App. filed Feb. 4, 1905. A battery switch for motor vehicles designed to make a good contact on either set of batteries for which the switch is positioned. The contact plates have notches to engage the switch blade so as to retain the latter in either position of its throw.

825,847. ELECTRIC CAR SIGNAL CIRCUIT; William Lintern, Cleveland, O. App. filed Aug. 22, 1905. The trolley car carries an accumulator battery which is automatically kept in charged condition, and in case of failure of the power circuit, the accumulator battery is automatically switched into circuit with the signal lamps so as to keep them lighted.

825,859. CURRENT DIRECTOR; James F. McElroy, Albany, N. Y. App. filed Sept. 15, 1899. A three-point switch particularly adapted for motor vehicles in which the switch arm has an abrupt movement between all of its positions. The switch is propelled by a follower spring and is temporarily restrained by a cam in each movement.

825,882. BATTERY; Charles W. Harper, Malden, Mass. App. filed

825,877. DYNAMO-ELECTRIC MACHINE; Paul Boucherot, Paris, France. App. filed May 12, 1905.